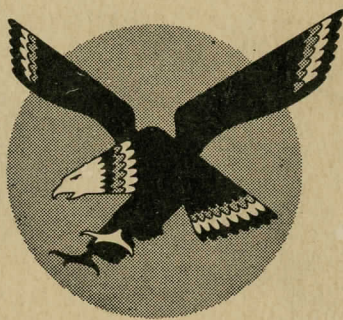


TOOL FABRICATION  
PROCEDURES MANUA



**C O N V A I R**

A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO



## FOREWORD

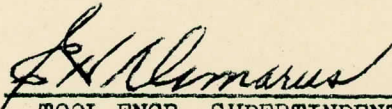
THE TOOL FABRICATION PROCEDURE MANUAL IS COMPILED BY THE TOOL DESIGN DEPARTMENT. IT IS INTENDED AS A SOURCE OF INFORMATION AND GUIDE FOR THOSE CONCERNED WITH THE FABRICATION AND INSPECTION OF THE TYPE OF TOOLS WHICH NORMALLY DO NOT HAVE INDIVIDUAL DESIGNS AT CONVAIR. TOOLS OF TYPES REFERRED TO ARE FABRICATED BY TOOL MANUFACTURING DEPARTMENTS TO A GENERAL PATTERN, TYPICAL EXAMPLES OF THESE ARE SHOWN IN THIS MANUAL. DUE TO WIDE VARIETY OF APPLICATIONS OF SOME OF THESE TYPES OF TOOLING, LIKE PLASTIC TOOLING, VARIATIONS AND IMPROVISATIONS ARE LEFT TO SHOP DESCRETION AND ONLY A FEW TYPICAL ONES ARE SHOWN HERE.

IN ORDER TO MAKE THIS MANUAL OF OPTIMUM VALUE AND KEEP ABREAST OF CHANGING METHODS AND IMPROVED TECHNIQUES, THOSE CONCERNED WITH FABRICATION OF TOOL TYPES INCLUDED HEREIN SHOULD CONTACT TOOL DESIGN, STANDARDS SECTION CONCERNING ANY SUGGESTED CORRECTIONS, NEW METHODS OR ADDITIONS THEY MIGHT DEEM ADVISABLE.

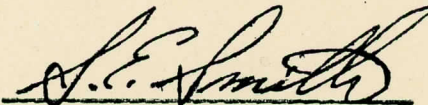


CHIEF TOOL ENGINEER

REVISED 11-1-56



TOOL ENGR. SUPERTINDENTENT



TOOL DESIGN SUPERVISOR

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CHECKED	ROBBINS 11-1-56		
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.25 CONTRASTING  
BLACK OR WHITE  
BORDER

OWNERSHIP	USAF PROP 8-8764-13 MKTP T806955 D/C "A" "M" DATE SN 170094	
PART NUMBER		
TOOL SYMBOL		
DRAWING CHANGE		

TOOL ORDER AND  
SERIAL NO.

.064 CLAD

MATERIAL

.28R

MAKE - 14 OPP

OPPOSITE HAND AND/OR  
AU (ALSO USE) IF ANY.

BEND RADIUS  
IF COMMON TO ALL BENDS  
OTHERWISE STAMP ADJACENT  
TO BEND OR MOLD LINES

STAMP THIS INFORMATION  
OUTSIDE PAINTED BORDER

\* WHEN TOOL NUMBERS ARE ASSIGNED

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COLOR CODE FOR STANDARD HOLE SIZES		
HOLE SIZE	STD. SIZE FOR	SAN DIEGO COLOR
#39 (.0995)	3/32 RIVET	RED
#30 (.1285)	1/8 RIVET	WHITE
#26 (.1470)	#6 & #4 SCR.	ORANGE
#20 (.1610)	5/32 RIVET	YELLOW
#18 (.1695)	#8 SCREW	GRAY
#16 (.1770)	PIL HL FOR 3/16 HUCK BOLT & HI SHEAR RIVET	BROWN
#11 (.1910)	3/16 RIVET	BLUE
#1 (.2280)	#10 SCREW	BLACK
#B (.2380)	PIL HL. FOR 1/4 HUCK BOLT & HI-SHEAR RIVET	TURQUOISE
#F (.2570)	1/4 RIVET	GREEN
9/32(.2812)	1/4 SCREW	PINK
9/16(.2968)	PIL. HL. FOR 5/16 HUCK BOLT & HI SHEAR RIVET	PURPLE
5/16(.3125)		SILVER
23/64(.3593)	PIL. HL. FOR 3/8 HUCK BOLT & HI SHEAR RIVET	GOLD

STANDARD HOLE SIZES DRILLED, PUNCHED

HOLE DIA.	MAX. PLUS TOL.	RIVET SIZE	SCREW-SIZES		DRTP HOLE SIZE	MPPE HOLE SIZE	PILOT HOLE SIZE	HOLE DIA.	MAX. PLUS TOL.	BOLT SIZE	PILOT HOLE SIZE	MPPE HOLE SIZE
			TIGHT	LOOSE								
.047	.006				.161		----	.086	.005			
.067	.006	1/16			.191	.375	----	.191	.005	3/16	.161*	.500
.099*	.006	3/32			.191	.375	----	.250-	.005	1/4	.228*	.500
.128*	.006	1/8	#4		.250	.375	■.099*	.312-	.005	5/16	.257*	.500
.147*	.006		#6	#4	.250	.375		.375-	.005	3/8	.312*	.625
.161*	.006	5/32		#6	.281	.375	.128*	.437-	.005	7/16	x	
.169*	.008		#8		.281	.375		.500	.005	1/2	x	
.191*	.008	3/16	#10	#8	.312	.375	.161*					
.228*	.008			#10	.312	.500	Ø.191*					
.257*	.008	1/4	1/4		.375	.500	Ø.228*					
.281*	.008			1/4	.437	.500	Ø.257*					
.323	.008	5/16										
.386	.008	3/8					.312					
.515	.008	1/2										

Ø FOR MATERIAL .080 OR UNDER  
USE .161 PIL.

\* MULTIPUNCH AVAILABLE IN THIS SIZE

x FOR PUNCHING WITH ROUND HOLE DIE USE .128 PILOT.

▲ WHEN A.N. BOLTS ARE NOT USED IN SHEAR THEY ARE CLASSIFIED AS SCREWS

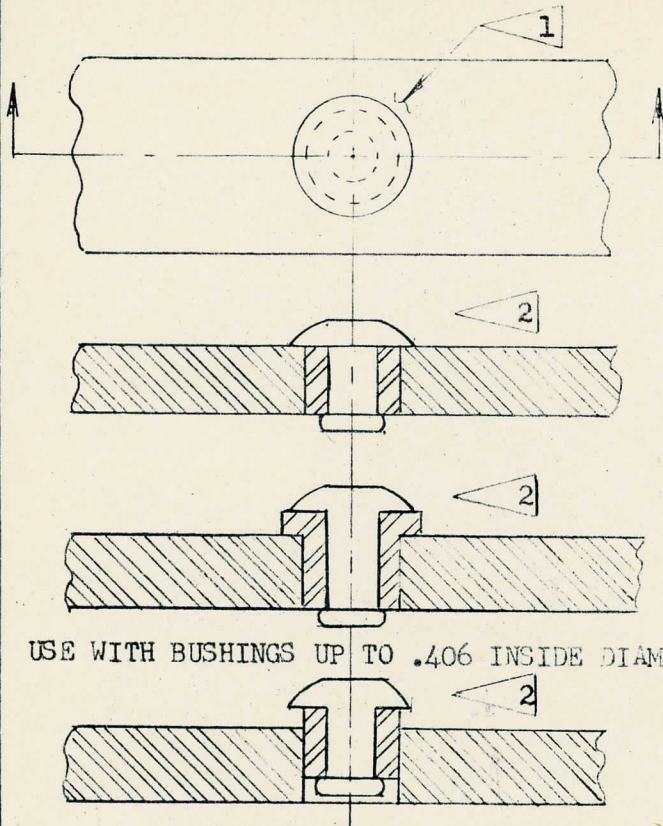
■ USE .116 DIA. PILOT HOLE WHEN MATERIAL IS OVER .080 THICKNESS AND IS IN ONE ATTACHING MEMBER ONLY. THIS APPLIES TO PCDI AND CNDI ONLY.

-- STANDARD REAMED SIZES

STANDARD HOLE SIZES

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USE WITH BUSHINGS UP TO .406 INSIDE DIAMETER

ALTERNATE METHOD WHEN REQUIRED

- 1 TOOL PROOF STAMP TO APPEAR HERE.
- 2 AN-470 RIVET AL. AL.
- 3 METAL PUNCHING TO SUIT (.06 MIN. THICKNESS)
- 4 STAKE (3) PLACES WITH CENTER PUNCH AS SHOWN

#### METHODS OF DELETING HOLES IN DRJI - DRPE - DRFX

WHEN A GROUP OF HOLES IS TO BE DELETED, USE 1/8 STEEL PLATE SECURED WITH SEVERAL SCREWS. ALL HOLE DELETIONS MUST BE TOOL PROOFED BEFORE USING TOOL FOR PRODUCTION.

#### FOR MPPE & ALL TEMPLATES

USE PUNCHING OF SAME MATERIAL,  
THICKNESS & HOLE DIA.  
TACK WELD & GRIND FLUSH.  
T.P. STAMP MUST APPEAR BEFORE  
USING TOOL FOR PRODUCTION.

SLIGHT C'S'K  
BOTH FACES OF  
TEMP.

TACK WELD & GR  
FLUSH PUNCHING

GLASS METHOD ACCEPTABLE  
SUB. FOR LARGE TABLE  
TYPE DRFX'S

CEMENT GLASS  
CLOTH

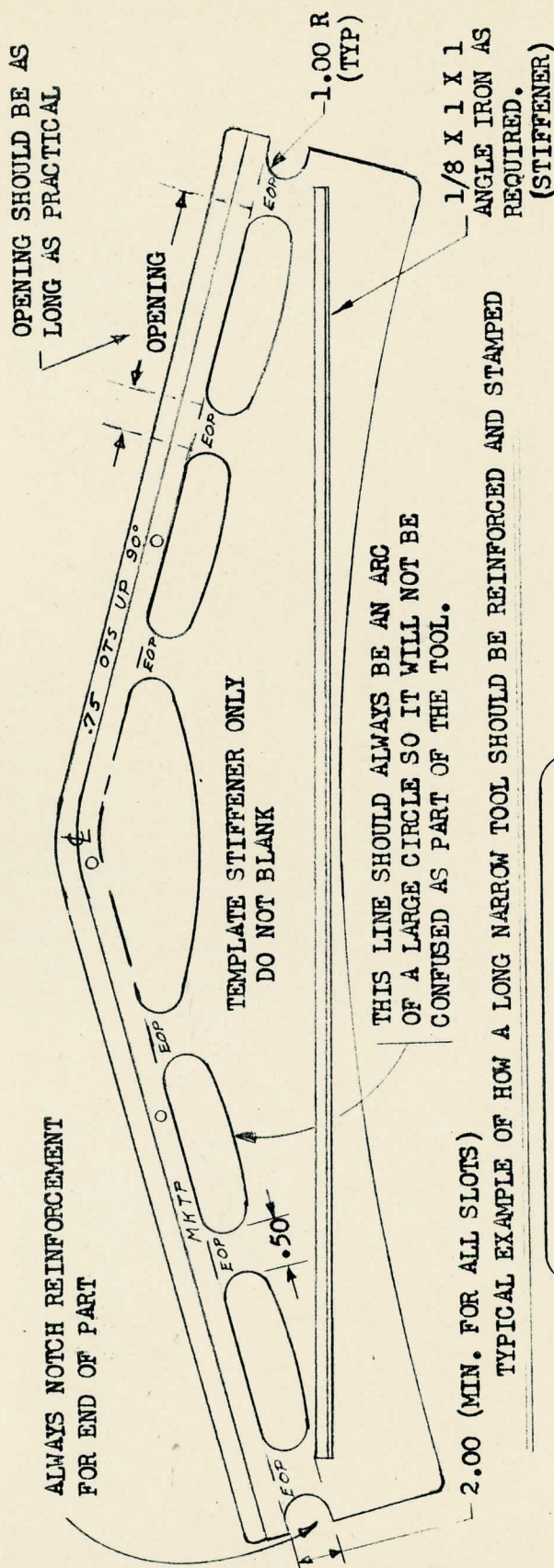
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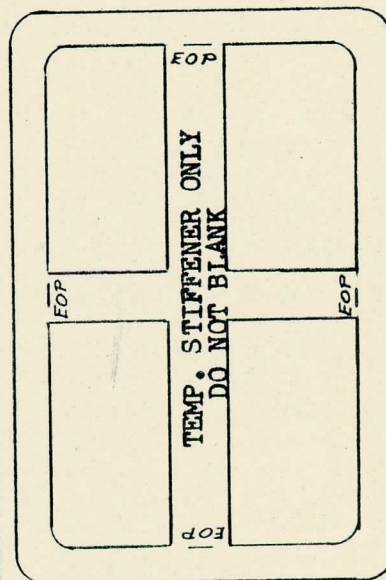
# TOOL LOFT PROCEDURE

## TOOL ILLUSTRATION

### REINFORCEMENT OF TOOLS



TOOLS REQUIRING REINFORCING STRIPS SHOULD BE PLAINLY MARKED AS SHOWN SO THAT REINFORCING STRIPS WILL NOT BE INCLUDED IN THE BLANKING DIE.



TYPICAL EXAMPLE OF A TOOL NEEDING REINFORCEMENT

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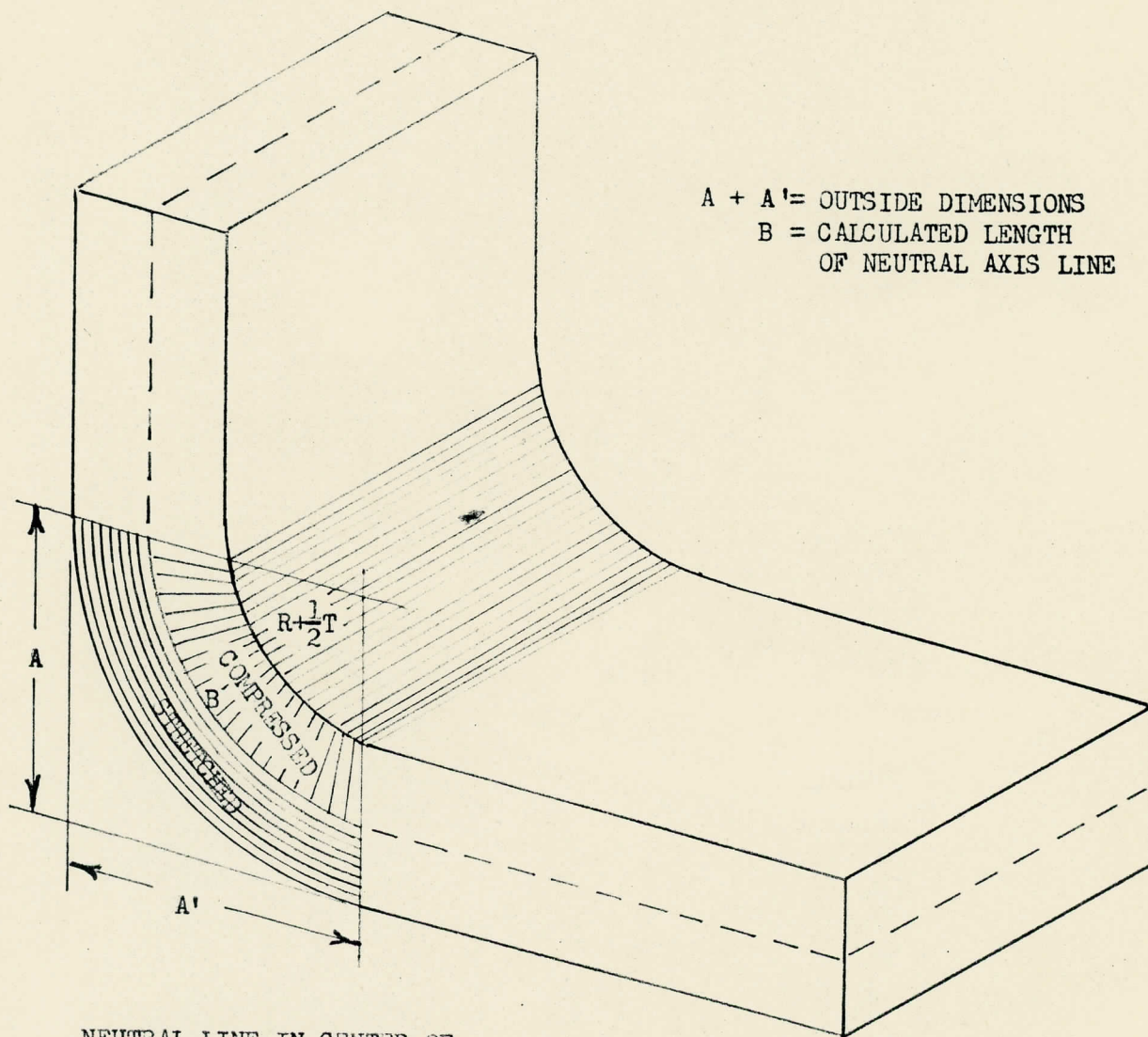
REINFORCEMENT OF TEMPLATES WHERE NEEDED

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PROCEDURES  
MANUAL

PAGE 10





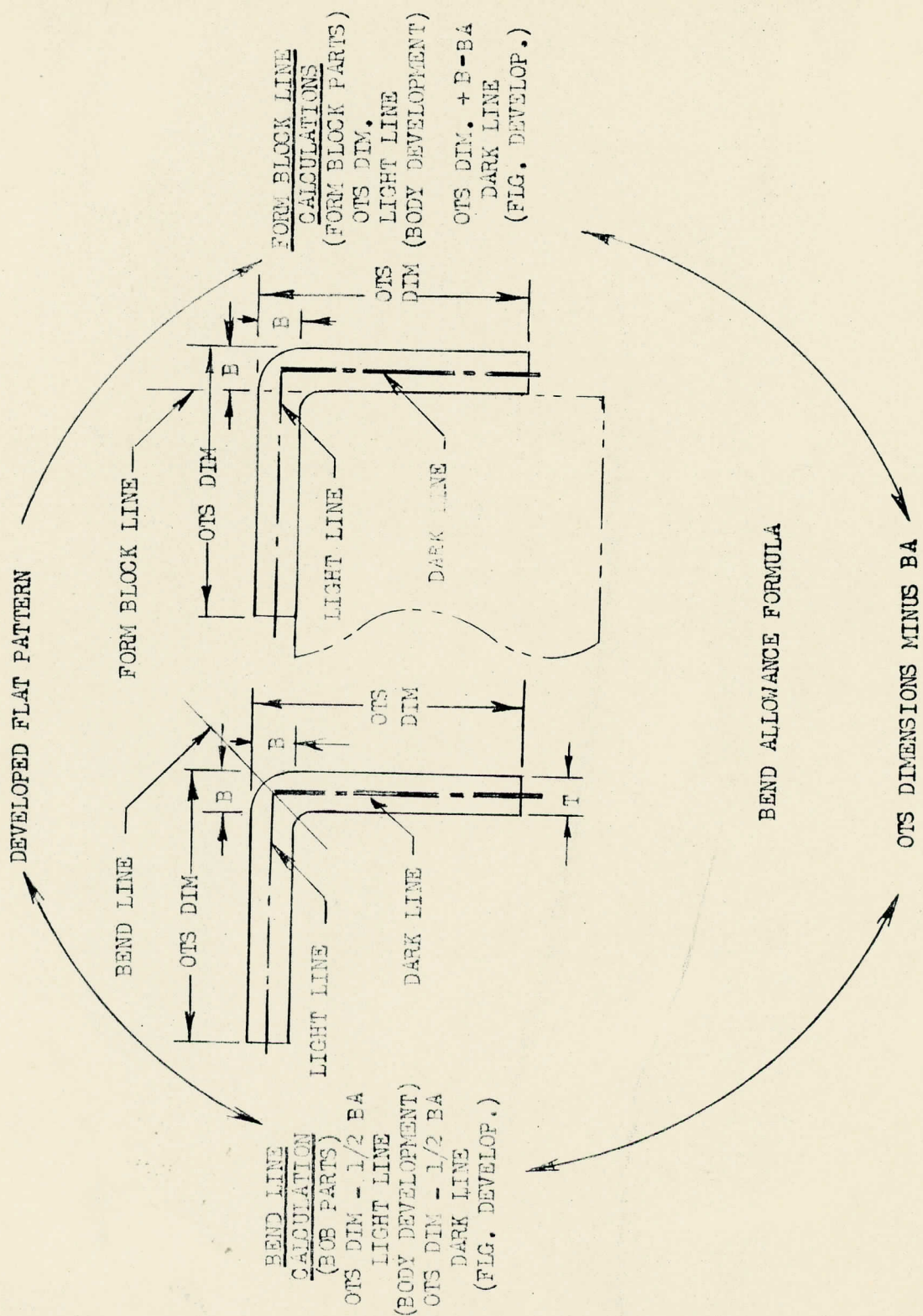
A + A' = OUTSIDE DIMENSIONS  
B = CALCULATED LENGTH  
OF NEUTRAL AXIS LINE

NEUTRAL LINE IN CENTER OF  
MATERIAL WHICH DOES NOT  
CHANGE IN LENGTH WHEN  
MATERIAL IS BENT.

DIFFERENCE BETWEEN A + A' AND B IS THE BEND ALLOWANCE FIGURED FROM TABLES

REFER TO CONVAIR "SET BACK TABLES" BOOK FOR CALCULATED SET BACK DIMENSIONS.

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FORM BLOCK LINE  
CALCULATIONS  
(FORM BLOCK PARTS)  
OTS DIM.  
LIGHT LINE  
(BODY DEVELOPMENT)  
OTS DIM. + B-BA  
DARK LINE  
(FIG. DEVELOP.)

BEND LINE  
CALCULATION  
(BOB PARTS)  
OTS DIM - 1/2 BA  
LIGHT LINE  
(BODY DEVELOPMENT)  
OTS DIM - 1/2 BA  
DARK LINE  
(FIG. DEVELOP.)

NOTE  
"B" = "T" AT 90°

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SETBACKS, EMPIRICAL FORMULA: WHEREAS THE DIFFERENCE BETWEEN "D + D" AND "E" EQUALS A SETBACK, THE EMPIRICAL FORMULA SHALL BE

$$\text{SETBACK} = 2 \left[ \frac{(R+T) \tan C}{2} \right] - \left[ .01745 R + .00872 T \right] C$$

SET BACKS, NON-STANDARD THICKNESS OR BEND RADII: REFER TO "KIR" AND "K2T" TABLES IN SET-BACK BOOK.

COMPARISON OF LINES REQUIRED FOR BEND ON BRAKE AND BLOCK FORMED PARTS: REFER TO FIGURES #1 AND #2.

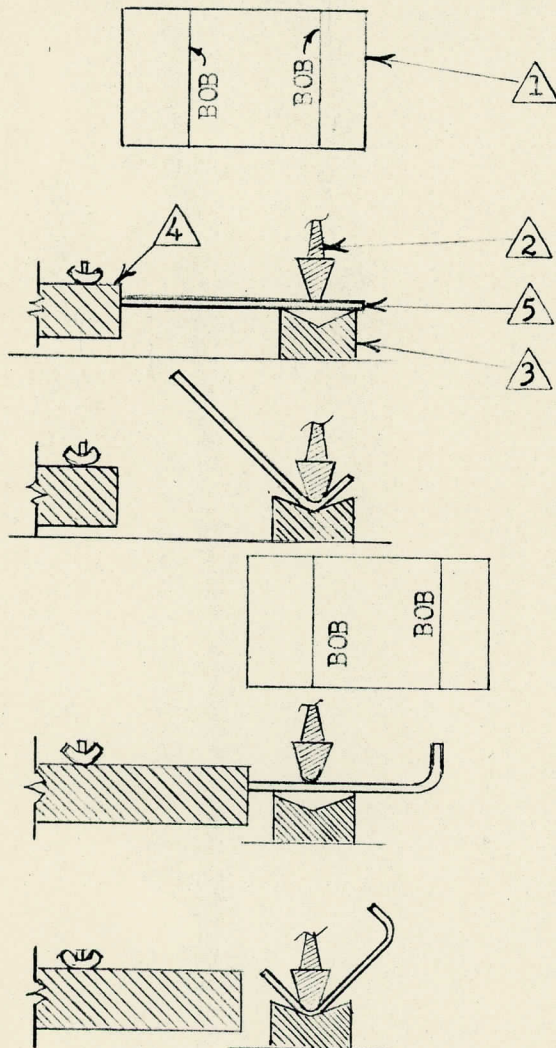


FIGURE #1

- ① TEMPLATE SHOWING BOB LINES
- ② BRAKE PUNCH
- ③ BRAKE DIE
- ④ ADJUSTABLE STOP
- ⑤ BLANKED PART

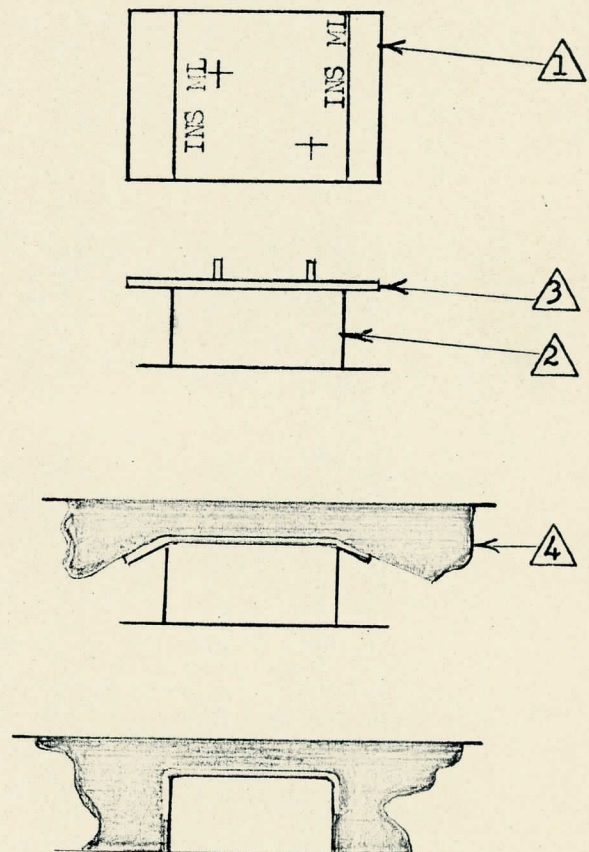


FIGURE #2

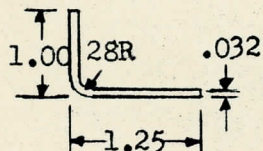
- ① TEMPLATE SHOWING INSIDE MOLD LINES
- ② FORM BLOCK
- ③ BLANKED PART
- ④ HYDRO-PRESS BLANKET

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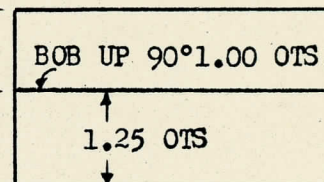
**FLAT PATTERN DEVELOPMENT FOR BEND ON BRAKE PARTS:** A BOB (BEND ON BRAKE) LINE REPRESENTS THE STRIKING PLANE OF THE BRAKE PUNCH (AND IS THE CENTER OF THE BEND). DEVELOPMENT FOR BOB REQUIRES SUBTRACTION OF ONE HALF OF A SETBACK FROM THE OUTSIDE FLANGE DIMENSIONS AT EACH BEND.

**EXAMPLE:**

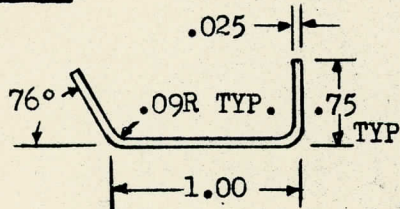


1.00 (OTS. DIMENSION)  
 $-.08$  (1/2 S.B.)  
 .92 DEVELOPED WIDTH

1.25 (OTS DIMENSION)  
 $-.08$  (1/2 S.B.)  
 1.17 DEVELOPED WIDTH



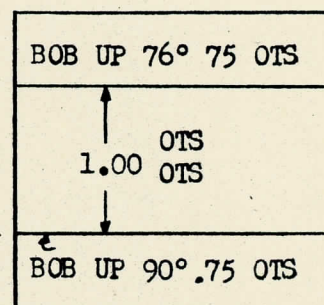
**EXAMPLE:**



.75 (OTS. DIMENSION)  
 $-.02$  (1/2 S.B. 76°)  
 .73 DEVELOPED WIDTH

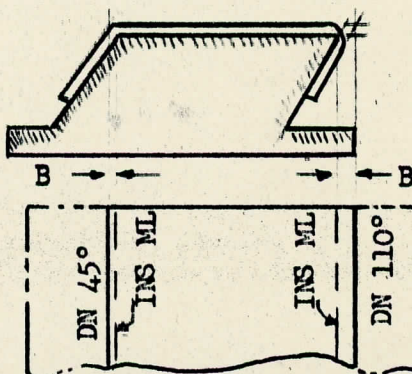
1.00 (OTS. - OTS. DIM.)  
 $-.055$  (1/2 S.B. 76° +  
 1/2 S.B. 90°)  
 .945 DEVELOPED WIDTH

.75 (OTS. DIMENSION)  
 $-.035$  (1/2 S.B. 90°)  
 .715 DEVELOPED WIDTH



**FLAT PATTERN DEVELOPMENT FOR BLOCK FORMED PARTS:** TEMPLATES FOR BLOCK FORMED PARTS (HYDRO-PRESS, IMPACT-FORM, HAND-FORMED, ETC.) INDICATE THE MOLD LINES REQUIRED FOR FABRICATION OF THE FORM BLOCKS. FLAT PATTERN DEVELOPMENT FOR BLOCK FORMED PARTS REQUIRES USE OF "B" DIMENSIONS AND SETBACKS.

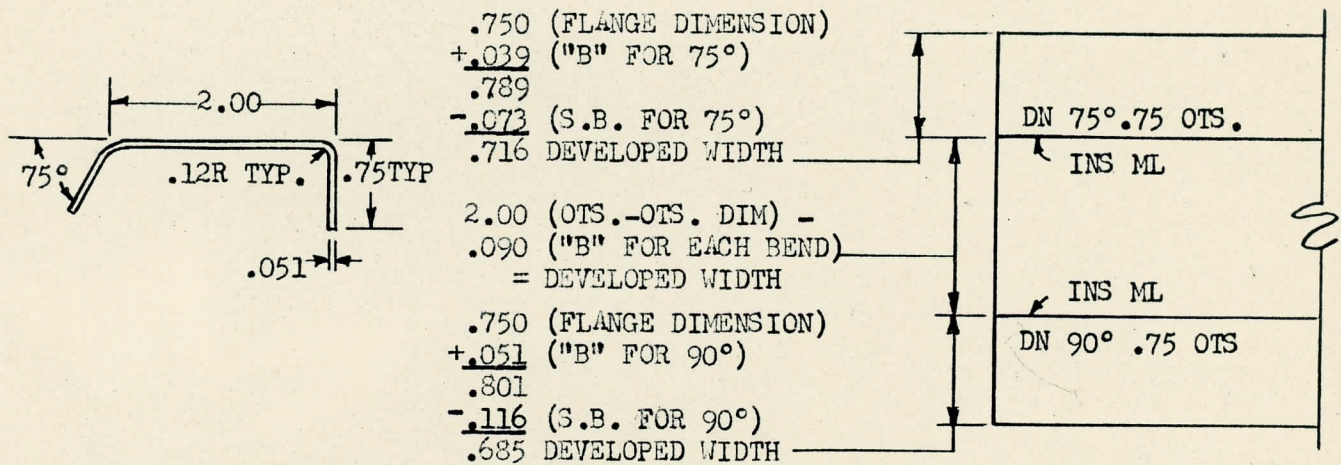
A "B" DIMENSION IS THE RELATIONSHIP OF INSIDE AND OUTSIDE MOLD LINES. "B" DIMENSIONS (AS TABULATED ACCORDING TO MATERIAL THICKNESS AND DEGREE OF BEND) WILL BE FOUND IN SET BACK BOOK.



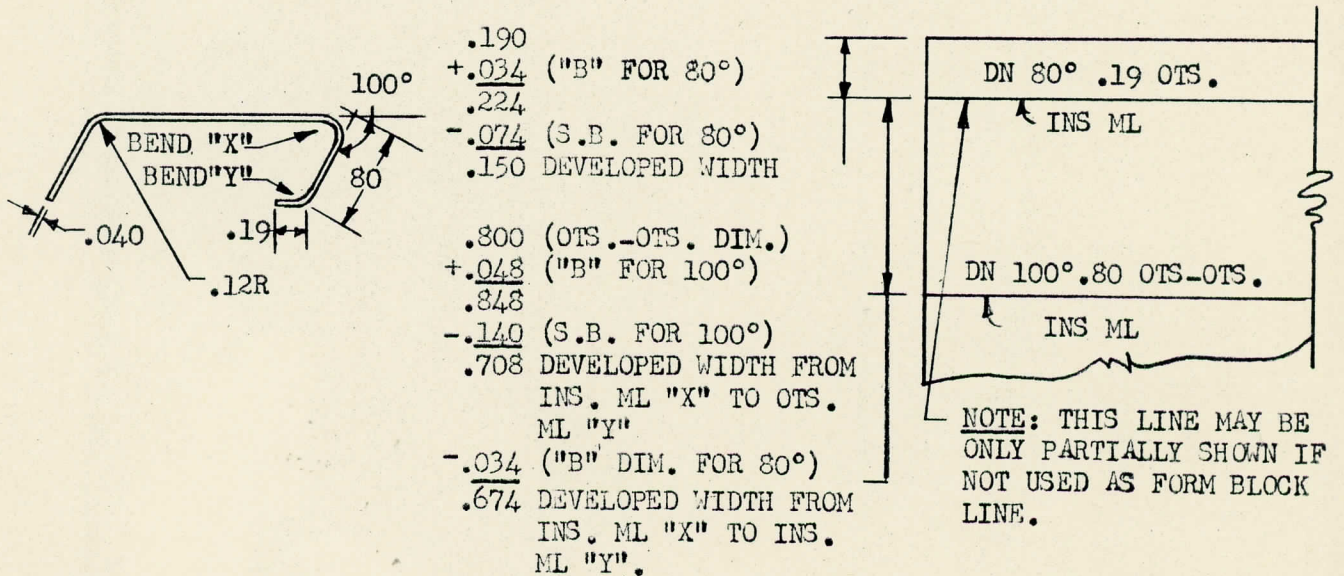
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TO DETERMINE FLANGE DEVELOPMENT FOR BLOCK FORMED FLAT PATTERNS, ADD A "B" DIMENSION TO THE FLANGE DIMENSION AND SUBTRACT A SETBACK.



DEVELOPMENT FOR ADDITIONAL FLANGES OR RETURN LIPS IS ACCOMPLISHED IN THE SAME MANNER AS SINGLE FLANGE DEVELOPMENT. PROCEEDING FROM THE WEB FACE, THE ADJACENT OUTSIDE-OUTSIDE FLANGE WOULD BE DEVELOPED INDICATING INSIDE MOLD LINE "Y".

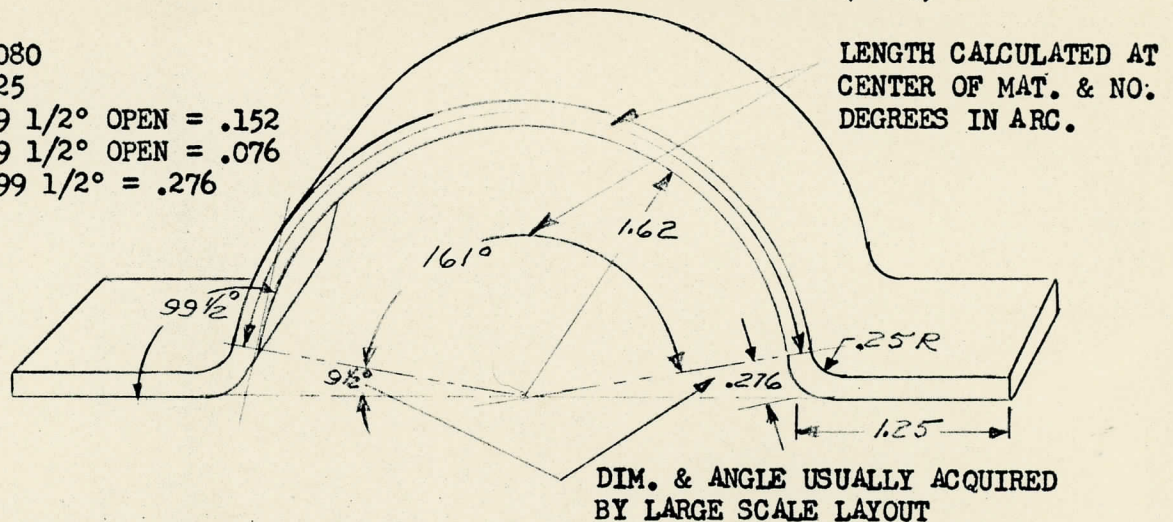


DRAWN	CAME 10-24-56	DEVELOPMENT FOR ADDITIONAL FLANGES OR RETURN LIPS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 19
APPROVED			



TYPICAL EXAMPLE  
BA TAKEN FROM "KIR" AND "K2T" SET BACK TABLES (REF.)

MAT = .080  
BR = .25  
BA FOR 9 1/2° OPEN = .152  
1/2BA FOR 9 1/2° OPEN = .076  
SB FOR 99 1/2° = .276



$$\frac{161}{360} (1.625 + 1.625 + .080) \times 3.1416 = 4.678 \text{ LENGTH ROLL SEGMENT}$$

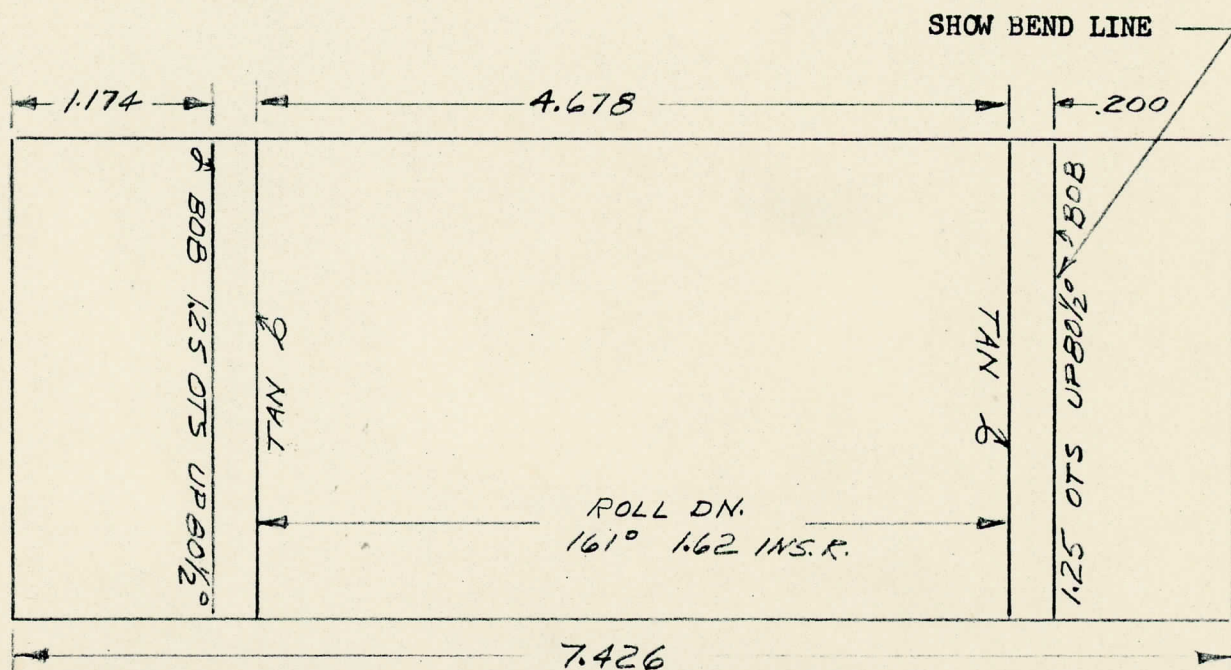
$$.276 + 1.25 - .152 = 1.374 \text{ LENGTH FLANGE \& BEND}$$

$$.276 - .076 = .200 \text{ DISTANCE BEND LINE TO TANGENT LINE}$$

$$1.25 - .076 = 1.174 \text{ DISTANCE BEND LINE TO END OF PART}$$

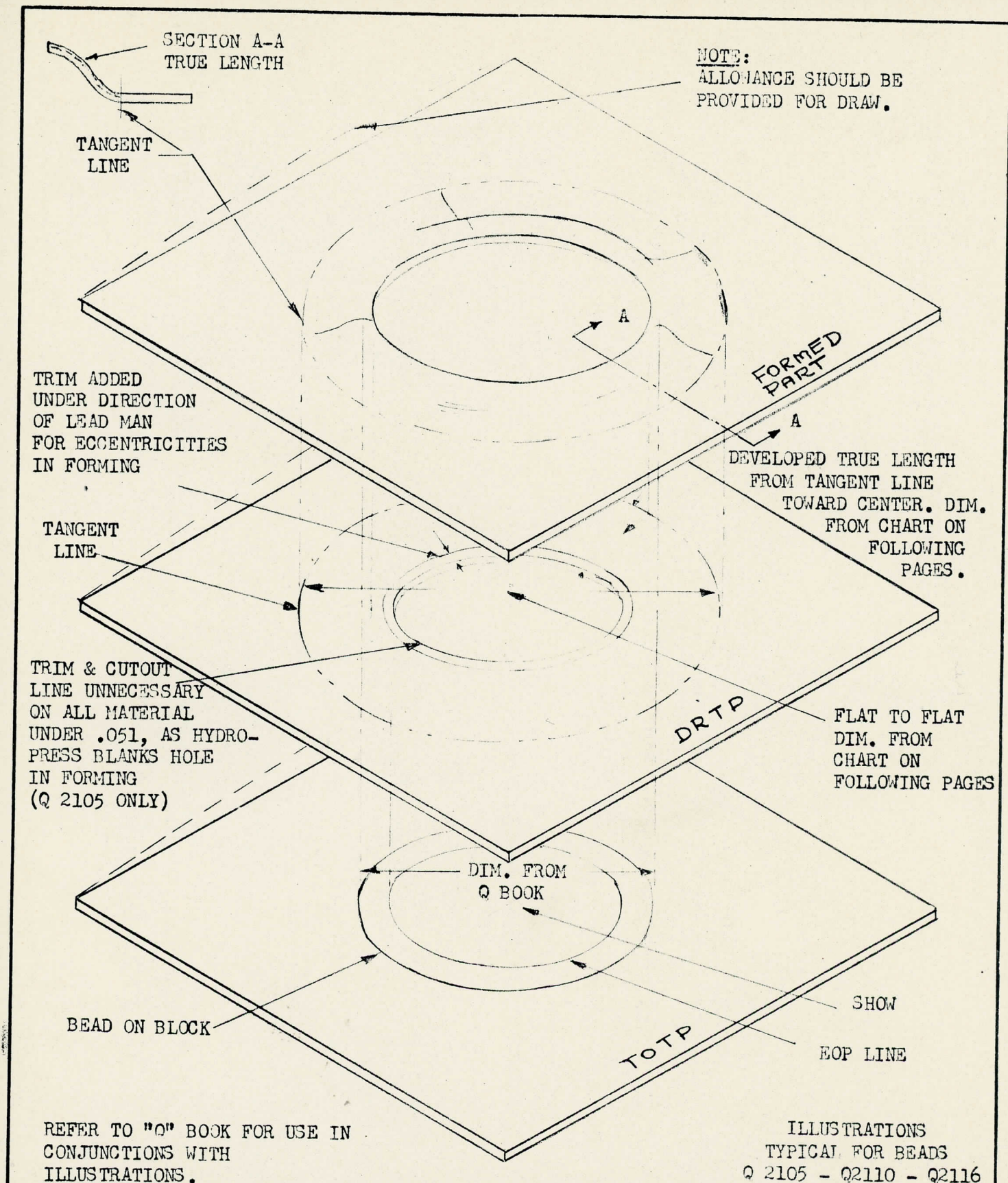
$$1.374 \text{ (CHECK)}$$

$$1.374 + 4.678 + 1.374 = 7.426 \text{ TOTAL DEVELOPMENT}$$



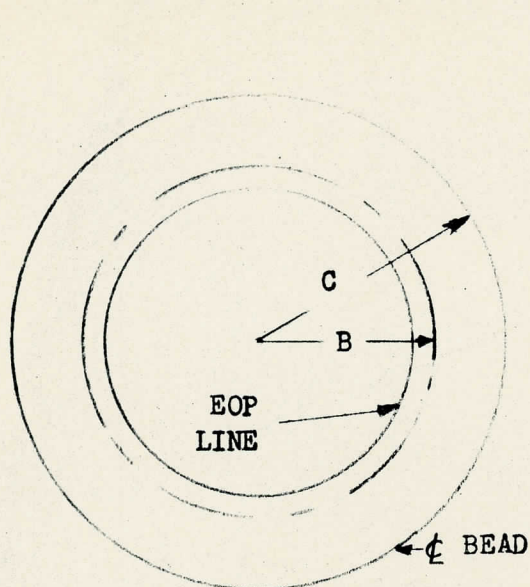
DRAWN	CAME 10-25-56	TEMPLATE DEVELOPMENT FOR BEND ON BRAKE-FORMED PARTS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 20
APPROVED			





DRAWN	CAME 11-1-56	DRILL TEMPLATE CIRCULAR BEAD APPLICATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-10		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 21
APPROVED			

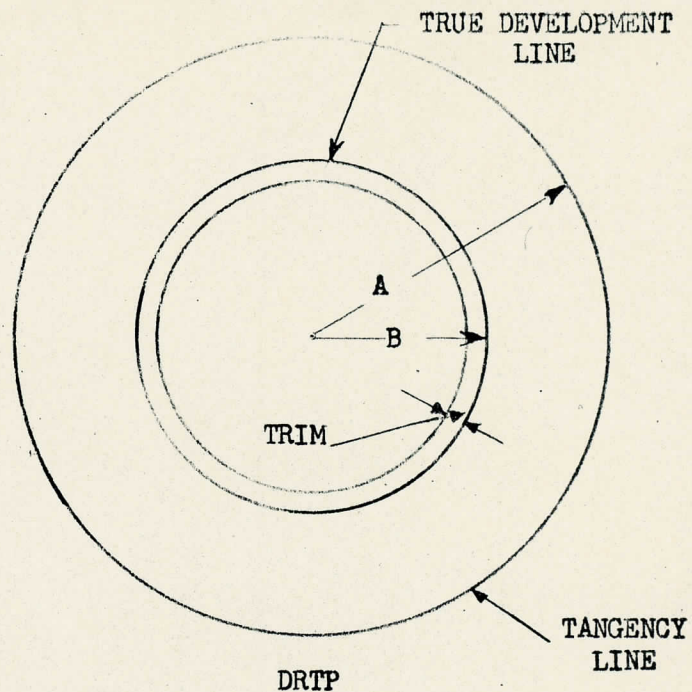




TOTP

FOR LINES REQUIRED ON TEMPLATES  
SEE PRECEEDING PAGE

REFERENCE: Q BOOK PAGE Q2105



DRTTP

TANGENCY  
LINE

Q2105 BEAD				
DASH NUMBER	TOTP		DRTTP	
	B *	C	A	B
1.375	.658	.75	1.125	.658
1.625	.783	.875	1.250	.783
1.875	.908	1.000	1.375	.908
2.125	1.033	1.125	1.500	1.033
2.375	1.138	1.250	1.703	1.138
2.625	1.263	1.375	1.830	1.263
2.875	1.388	1.500	1.953	1.388
3.125	1.513	1.625	2.078	1.513
3.375	1.638	1.750	2.203	1.638
3.875	1.888	2.000	2.453	1.888
4.375	2.108	2.250	2.750	2.108
4.875	2.358	2.500	3.000	2.358
5.375	2.608	2.750	3.250	2.608
5.875	2.858	3.000	3.500	2.858

\* "B" DIMENSION TO HAVE TRIM SUBTRACTED FROM IT FOR E.O.P. LINE ON TOTP.

DRAWN	CAME 11-1-56	DRILL TEMPLATE CIRCULAR BEAD APPLICATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-15-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 22
APPROVED			



BEAD PROCEDURE  
CHART TO BE USED IN CONJUNCTION WITH B DIMS  
GIVEN IN Q BOOK UNDER Q 2116

MATERIAL	Q 2116			
	5/16 DEPTH		7/16 DEPTH	
	DIMS. TO BE ADDED TO RADII FOR TANGENCY OUTSIDE OF GIVEN BEAD (TANGENT LINE)	* DEVELOPED TRUE LENGTH DIM. TOWARD CENTER FROM TANGENCY INC. 1/16 FLAT	DIMS. TO BE ADDED TO RADII FOR TANGENCY OUTSIDE OF GIVEN BEAD (TANGENT LINE)	* DEVELOPED TRUE LENGTH DIM. TOWARD CENTER FROM TANGENCY INC. 1/16 FLAT
.020	.5525	.7285		
.025	.5562	.7292		
.032	.5590	.7300		
.040	.5635	.7332	.7780	.9965
.051	.5680	.7365	.7850	1.0025
.064	.5742	.7430	.7920	1.0085
.072	.5805	.7495	.7967	1.0100
.081	.5855	.7530	.8015	1.0125
.091	.5905	.7565	.8072	1.0175
.102	.6000	.7660	.8130	1.0225
.125	.6095	.7755	.8250	1.0345

\* TRIM TO BE ADDED FROM THIS LINE TOWARD CENTER OF BEAD UNDER DIRECTION OF LEAD MAN.

Q 2156 BEAD

GAGE	-4	-7	-10	-14	-20
.020	7/8	1	1-1/4		
.032	1	1-1/4	1-1/4		
.040	1	1-1/4	1-1/2	1-7/8	
.051	1-1/4	1-3/8	1-5/8	2	
.064	1-1/2	1-5/8	1-7/8	2-1/4	
.072	1-1/2	1-3/4	2	2-3/8	
.081	1-5/8	1-7/8	2-1/8	2-1/2	
.091		2	2-1/4	2-5/8	3-1/4
.102		2-3/16	2-5/16	2-3/4	3-3/8
.128			2-3/8	3	3-1/2
.156			3	3-1/2	4

FLAT TO FLAT DISTANCE  
FOR LINES REQUIRED ON TEMPLATES SEE PRECEDING PAGES

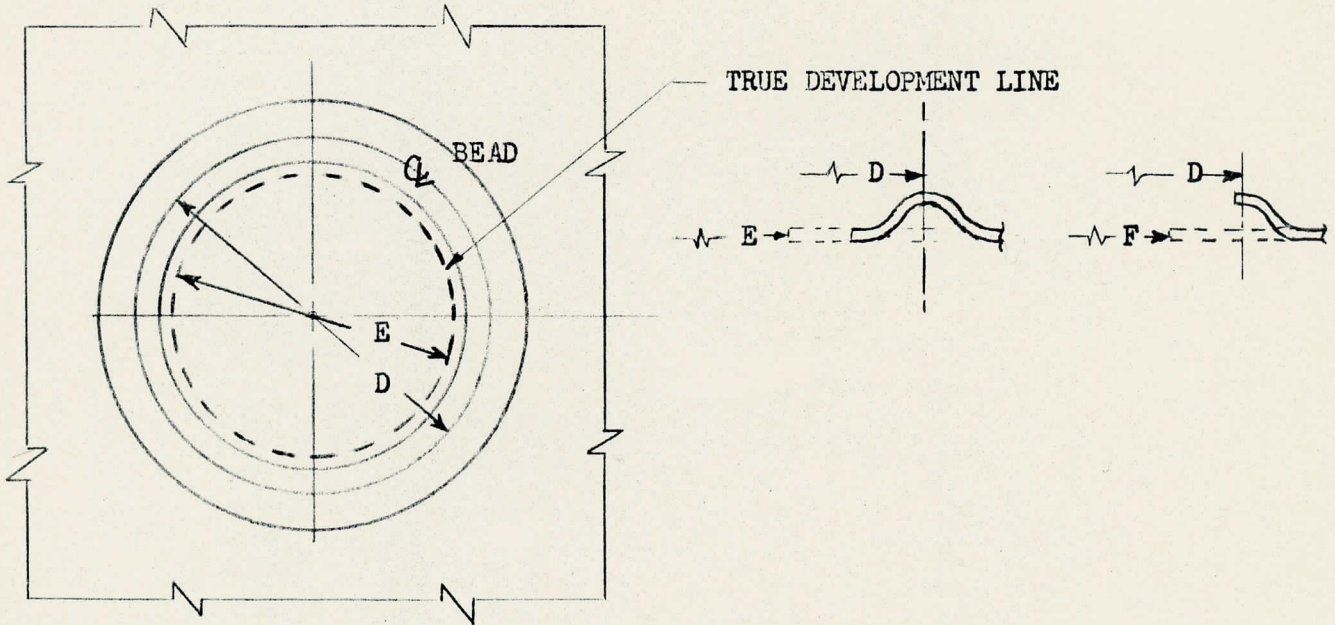
DRAWN	CAME 10-15-56	HYDRO PRESSED PARTS TEMP DEVELOPMENT  <b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> SAN DIEGO	TOOL FABRICATION PROCEDURES MANUAL  PAGE 23
CHECKED	ROBBINS 10-20-56		
APPROVED			
APPROVED			



# CHARTS & TABLES

## BEAD PROCEDURE

Q 2106



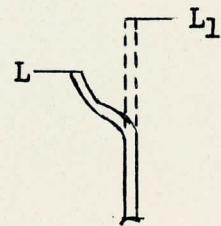
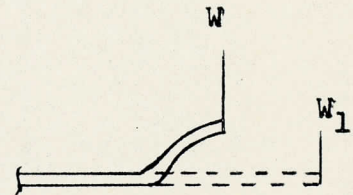
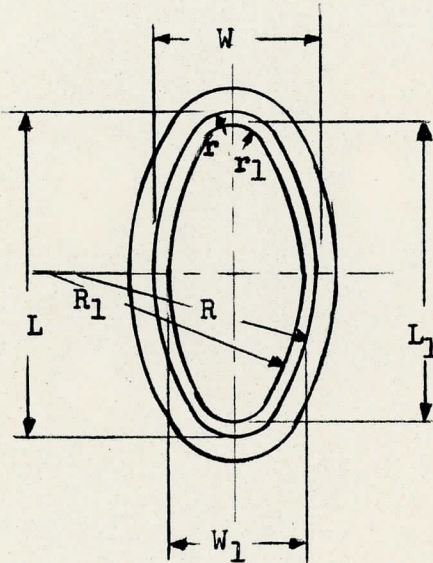
DASH NO.	D	SEMI BEADED E	FULL BEADED F
3.5	3.5	3.15	1.80
4	4	3.65	2.30
4.5	4.5	4.15	2.80
5	5	4.65	3.30
6	6	5.65	4.30
7	7	6.65	5.30
7.5	7.5	7.15	5.80
8	8	7.65	6.30
9	9	8.65	7.30
11	11	10.65	9.30

DRAWN	CAME 11-1-56	HYDRO PRESSED PARTS MARK TEMP DEVELOPMENT	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-10		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 24
APPROVED			



# BEAD PROCEDURE

Q 2110



DASH NO.	$W_1$	$L_1$	$R_1$	$r_1$
4.0	1.8438	3.8438	3.8594	.64065
4.25	1.9688	4.0938	3.9844	.6719
4.75	2.2188	4.5938	4.2969	.77565
5.625	2.6563	5.4688	4.9844	.89065
6.5	3.0938	6.3438	5.6719	1.0162
7.0	3.3438	6.8438	6.20315	1.110
8.5	4.0938	8.3438	7.45315	1.32815

DRAWN	CAME 11-1-56
CHECKED	ROBBINS 11-10
APPROVED	
APPROVED	

TEMPLATE DEV. - OVAL BEAD APPLICATION

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TOOL FABRICATION  
PROCEDURES  
MANUAL

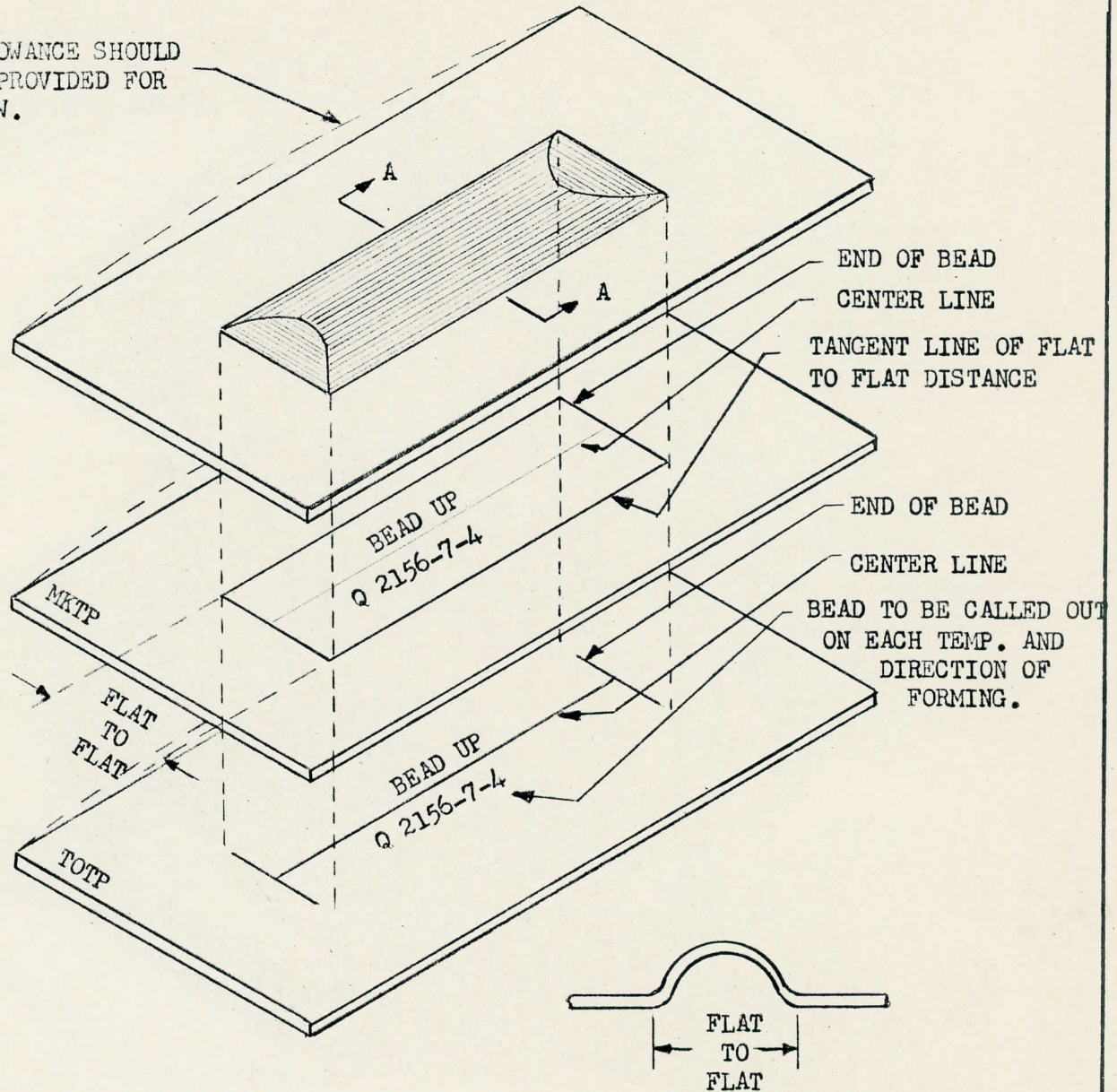
PAGE 25



# TYPICAL EXAMPLE OF LINES TO BE SHOWN ON MKTP & TOTP

## NOTE:

ALLOWANCE SHOULD  
BE PROVIDED FOR  
DRAW.



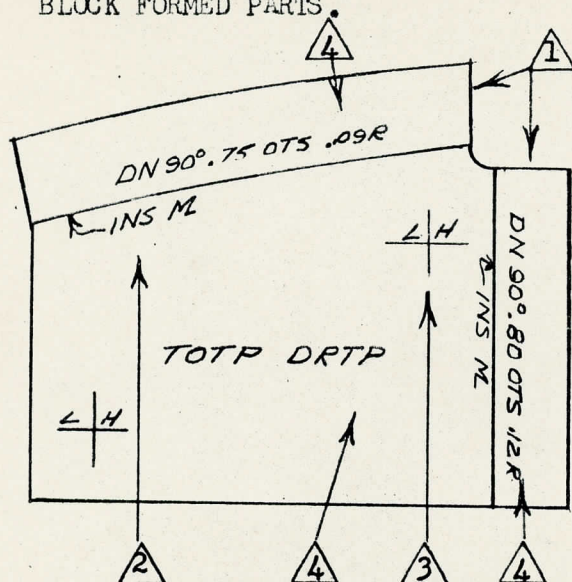
NOTES: FLAT TO FLAT DISTANCE MAY BE OBTAINED FROM HYDRO-PRESS MANUAL SECTION.  
FOR ADDITIONAL INFORMATION CHECK Q BOOK.

A COMPLETE SET OF PYRALIN TEMPLATES ARE AVAILABLE AT THE LOFT  
B/P FILES. HOWEVER, THE TEMPLATES SHOULD ONLY HAVE POINTS TRANS-  
FERRED FROM THEM AND NOT BE SCRIBED AROUND AS THE SCRIBE WILL MAR  
THE PYRALIN AND RENDER THE TOOL UNUSABLE.

DRAWN	CAME 11-1-56	MARK TEMPLATE - STRAIGHT BEAD APPLICATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-10		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 26
APPROVED			

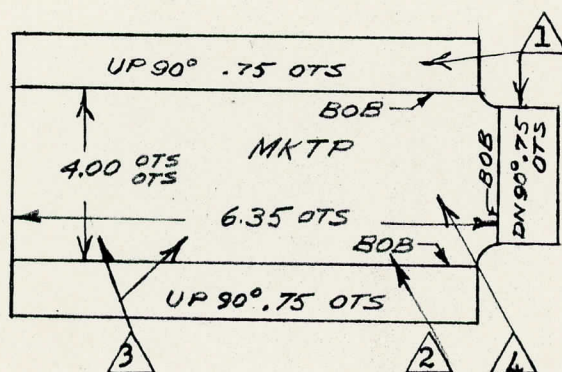


INFORMATION TO BE SHOWN ON TEMPLATES: SHALL SHOW ALL INFORMATION REQUIRED FOR THE FABRICATION OF TOOLS AND BLANKED PARTS, AND INSPECTION OF COMPLETED BLOCK FORMED PARTS.

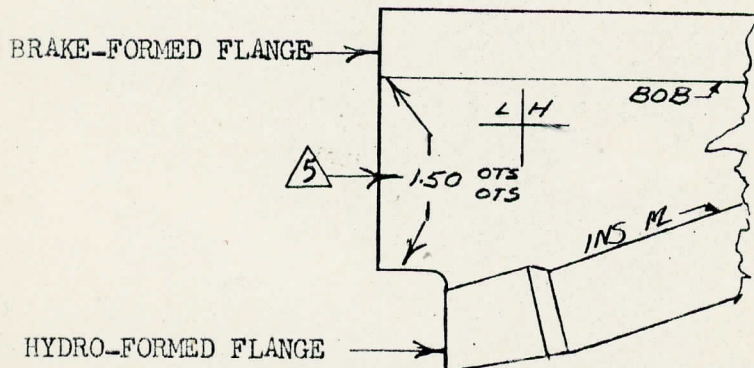


- 1 FLANGE CALLOUTS SHALL APPEAR ON DEVELOPED FLANGES.
- 2 INSIDE MOLD LINE SHALL BE SHOWN AND LABELLED
- 3 LOCATING HOLES SHALL BE POSITIONED SO AS TO FOOL PROOF PLACEMENT OF BLANKED PART ON FORM BLOCK.
- 4 BEND RADII SHALL APPEAR AS PART OF TOOL CALLOUT EXCEPT WHEN SAME RADII DOES NOT APPLY TO ENTIRE PART (SUCH AS ON EXAMPLE SHOWN).

INFORMATION TO BE SHOWN ON TEMPLATES: SHALL SHOW ALL INFORMATION REQUIRED FOR THE FABRICATION OF TOOLS AND INSPECTION OF COMPLETED BRAKE FORMED PARTS.



- 1 FLANGE CALLOUTS SHALL APPEAR ON DEVELOPED FLANGES.
- 2 BOB LINES SHALL BE SHOWN AND LABELLED.
- 3 OUTSIDE DIMENSIONS OF BODY PLANE OF PART SHALL BE DIMENSIONED AS SHOWN.
- 4 BEND RADII SHALL APPEAR AS PART OF TOOL CALLOUT EXCEPT WHEN SAME RADII DOES NOT APPLY TO ENTIRE PART.
- 5 PARTS HAVING ANY BRAKE FORMED FLANGES SHALL SHOW THE DIMENSIONS RELATED TO BRAKE FORMED FLANGE.



DRAWN	CAME 10-22-56
CHECKED	ROBBINS 10-25-56
APPROVED	
APPROVED	

INFORMATION TO BE SHOWN ON TEMPLATES

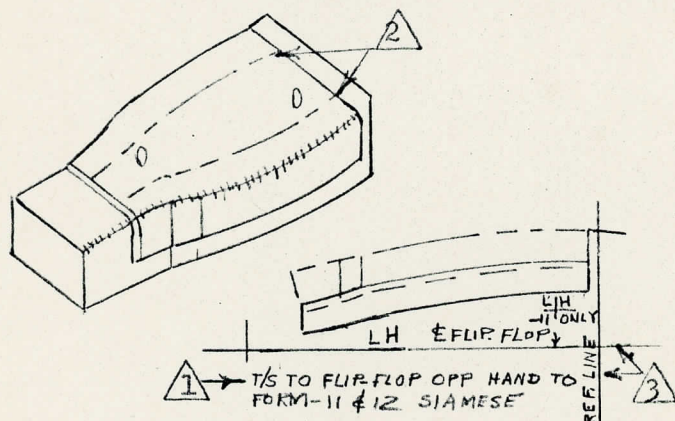
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TOOL FABRICATION  
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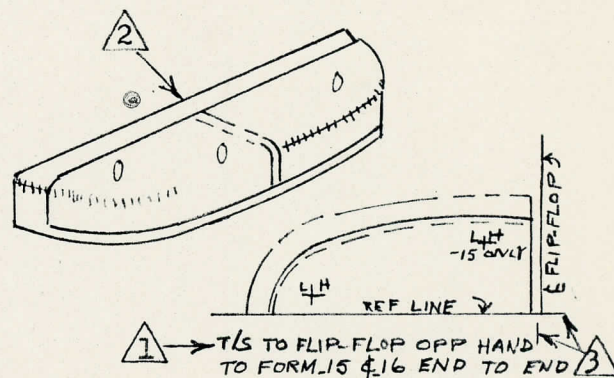
**MULTIPLE FORMING:** TEMPLATES FOR PARTS FORMED IN MULTIPLE QUANTITIES SHALL INDICATE QUANTITY TO BE MADE. LOFT SHOWS ONLY ONE DETAIL DEVELOPED IN ASSEMBLED POSITION, WITH INFORMATION AND REFERENCE LINES BEING PROVIDED TO ENABLE MULTIPLE TEMPLATE TO BE FABRICATED FROM SINGULARLY SHOWN PART.



1 NOTED ON LOFT LAYOUT.

2 TRIMMED AFTER FORMING

SIAMESE FORMING

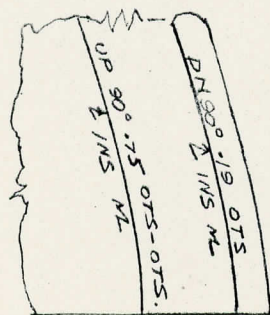


3 PROVIDE REFERENCE SYSTEM FOR  
TEMPLATE FABRICATION

END-TO-END FORMING

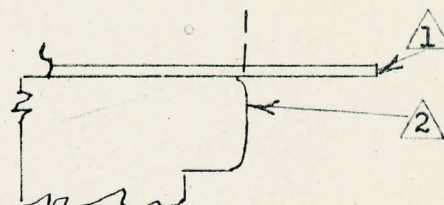
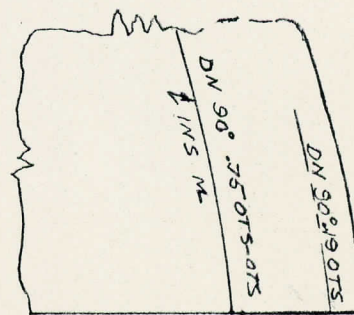
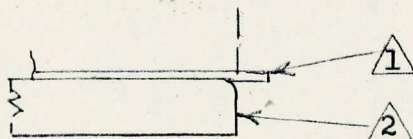
**BLOCK FORMED RETURN FLANGES:** WHEN THE RETURN FLANGE ON A BLOCK FORMED PART IS USED AS FORM BLOCK LINE, IT SHALL BE SHOWN AND LABELLED AS INSIDE MOLD LINE.

WHEN THE RETURN FLANGE ON A BLOCK FORMED PART IS NOT USED FOR BLOCK LINE, A PARTIAL LINE ADJACENT TO RETURN FLANGE CALLOUT SHALL BE SHOWN.



1 BLANKED MATERIAL

2 FORM BLOCK



DRAWN	CAME 10-22-56
CHECKED	ROBBINS 10-25-56
APPROVED	
APPROVED	

INFORMATION TO BE SHOWN ON TEMPLATES

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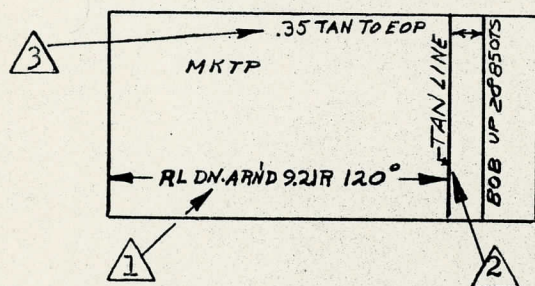
SAN DIEGO

TOOL FABRICATION  
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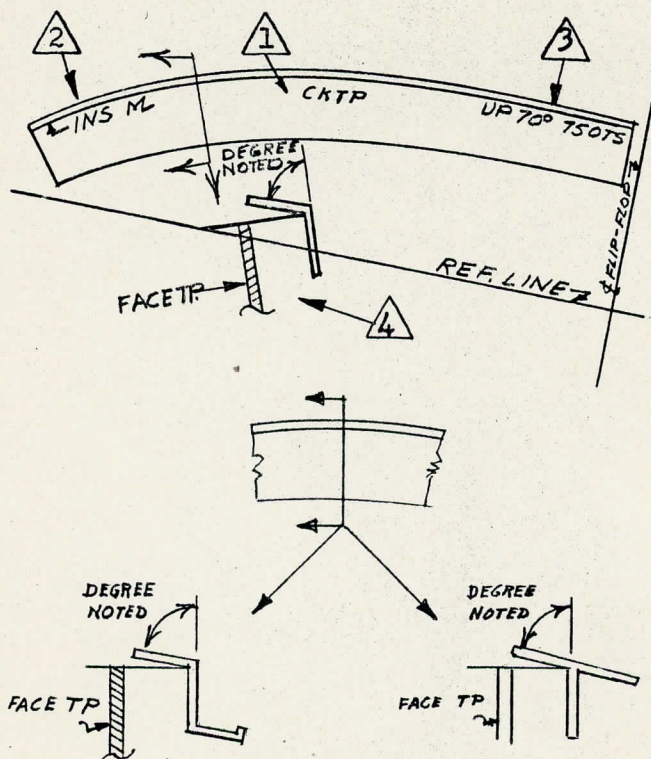


INFORMATION TO BE SHOWN ON TEMPLATES FOR ROLL-FORMED PARTS: SHALL SHOW ALL INFORMATION REQUIRED FOR THE FABRICATION OF TOOLS AND INSPECTION OF COMPLETED ROLL-FORMED PARTS.



- 1 DIRECTION AND RADIUS OF ROLL SHALL BE CALLED OUT.
- 2 TANGENCIES OF ROLL RADII SHALL BE CALLED OUT.
- 3 DIMENSIONS FROM TANGENCIES TO EOP LINES SHALL BE CALLED OUT.

INFORMATION TO BE SHOWN ON CKTP'S: SHALL SHOW INFORMATION REQUIRED FOR (1) THE FABRICATION OF FORMING TOOLS, (2) TRIMMING AND INSPECTION OF FORMED PARTS.



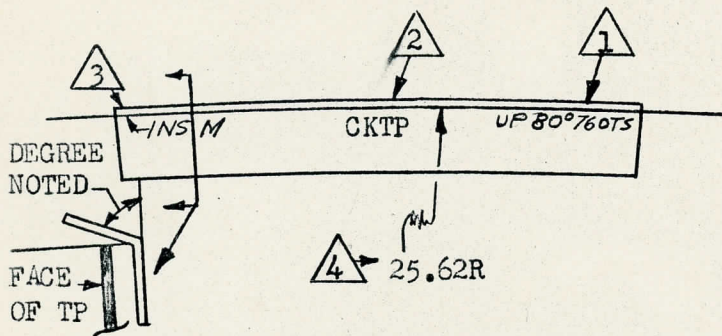
- 1 TOOL CALLOUT SHALL BE SHOWN ON BODY OF PART
- 2 THE MOLD LINE REQUIRED FOR TOOLING SHALL BE LABELLED.
- 3 DEGREE OF BEND AND FLANGE CALLOUT SHALL BE LABELLED ON THE BODY OF THE PART.
- 4 A SECTION VIEW SHALL BE TAKEN, CLEARLY SHOWING THE PART AND THE MOLD LINE REQUIRED FOR TOOLING. THIS VIEW SHALL ALSO SHOW TEMPLATE APPLICATION AND INDICATE ORIENTATION OF BEVEL ANGLE CALLOUT.
- 5 TEMPLATE APPLICATION FOR PARTS, SUCH AS TEES AND ZEES SHALL SHOW NORMAL BEVEL ANGLE CALLOUT (DO NOT INDICATE AS DEGREES OPENED OR CLOSED), AND INDICATE ORIENTATION OF BEVEL ANGLE CALLOUT.

CKTP'S FOR END-TO-END FORMING: WHEN PARTS ARE TO BE FORMED END-TO-END, ONLY ONE PART NEED BE SHOWN. COMPLETE INFORMATION SHALL APPEAR ON THE SINGLE PART SHOWN. IF PART APPEARS IN ASSEMBLED VIEW (OR FULL LENGTH MOLD LINE FOR ENTIRE TEMPLATE IS NOT SHOWN) INFORMATION AND REFERENCE LINES SHALL BE PROVIDED TO ENABLE MULTIPLE TEMPLATE TO BE FABRICATED FROM SINGULAR PART SHOWN ON CKTP.

DRAWN	CAME 10-22-56	INFORMATION TO BE SHOWN ON TEMPLATES	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 10-25-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION  SAN DIEGO</small>	PAGE 33
APPROVED			

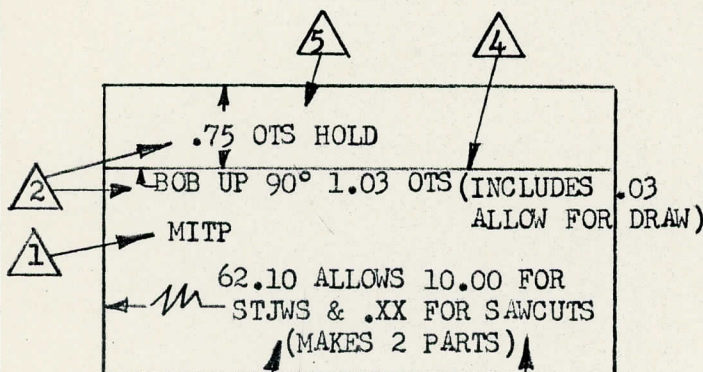


CKTP'S FOR MULTIPLE-FORMED PARTS (MADE ON STFM OR WPFM) HAVING RADIAL MOLD LINE AND CONSTANT BEVEL ANGLE: WHEN PARTS BEING FORMED END-TO-END HAVE A RADIAL MOLD LINE AND A CONSTANT BEVEL ANGLE, ONLY ONE PART SHALL BE SHOWN, AND IN ADDITION TO NORMAL CKTP INFORMATION SHALL INDICATE THE MOLD LINE RADIUS.

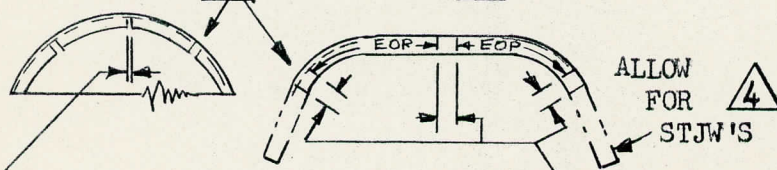


- 1 CONSTANT BEVEL ANGLE.
- 2 NORMAL CKTP CALLOUT.
- 3 MOLD LINE REQUIRED FOR TOOLING.
- 4 SHOW THIS CALLOUT.

INFORMATION TO BE SHOWN ON MITPS: MITP'S SHALL BE MADE TO A MINIMUM OF 10.00 LENGTH EXCEPT WHERE IMPRACTICAL. FOR PARTS TO BE STRETCHED OR WIPER-FORMED, THE MITP IN ADDITION TO NORMAL TOOL CALLOUT SHALL SHOW (1) LENGTH CALLOUT INDICATING QUANTITY OF PARTS PROVIDED FOR, AND ALLOWANCES FOR SAWCUTS AND STJW'S, (2) MATERIAL ADDED FOR DRAW, AND (3) CALLOUT INDICATION OF FLANGE DIMENSION REQUIRED TO BE HELD TO PROPERLY BUTT WITH THE BACKING STRIP OF STFM OR WPFM.



- 1 NORMAL TOOL CALLOUT
- 2 NORMAL "BOB" FORMING INFORMATION
- 3 LENGTH OF BLANKED MATERIAL SHALL BE DIMENSIONED AS SHOWN AND CALLOUT SHALL INCLUDE ALLOWANCE MADE FOR STJW'S, SAWCUTS, ETC. STANDARD ALLOWANCE FOR STJW'S IS 5.00 FOR EACH END; CONTOUR ROLLED AND WIPER FORMED PARTS REQUIRE A MINIMUM OF 6.00 FLAT EACH SIDE OF CONTOURED AREA.



ALLOWANCE FOR MATERIAL DRAW SHALL BE INCLUDED IN THE DEVELOPMENT OF LEG REQUIRING ADDITIONAL MATERIAL, AND BE INDICATED AS SHOWN.

CONTOURED PARTS IN DOUBLE LENGTHS REQUIRE 1.00 ALLOWANCE FOR SAWCUTS.

MULTIPLE PARTS FORMED TO A RADIUS HAVING A CONSTANT BEVEL ANGLE AND STRAIGHT TRIM REQUIRE .125 ALLOWANCE FOR SAWCUTS.

- 5 CALLOUT FOR THE FLANGE BUTTING THE BACKING STRIP SHALL BE NOTED AS A "HOLD" DIMENSION.
- 6 INDICATE NUMBER OF PARTS PROVIDED FOR WHEN USED FOR MULTIPLE FORMING.

DRAWN	CAME 10-22-56
CHECKED	ROBBINS 10-25-56
APPROVED	
APPROVED	

INFORMATION TO BE SHOWN ON TEMPLATES

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VARYING FLANGE DEVELOPMENT FOR MITP'S: ON PARTS HAVING A CONSTANTLY VARYING BEVEL ANGLE (IN ONE DIRECTION, NOT REVERSING) MITP'S SHALL BE DEVELOPED TO PROVIDE THIS VARIANCE PER THE FOLLOWING METHODS:

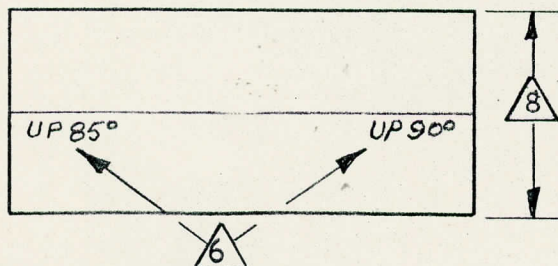
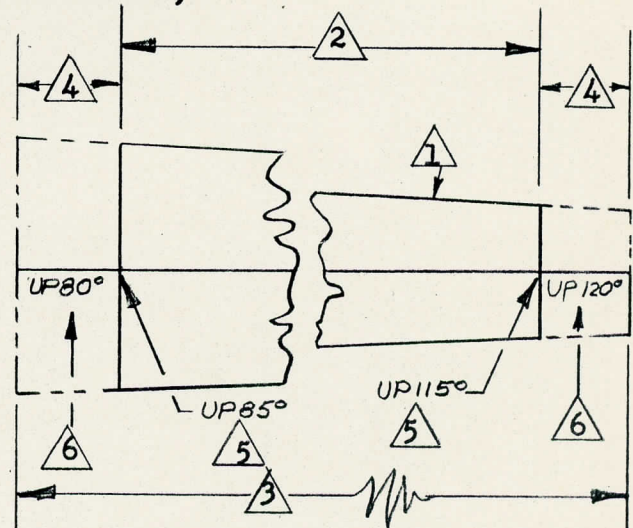
METHOD 1: WHEN FLAT PATTERN DEVELOPMENT AT EACH END OF PART DIFFERS BY .05 OR MORE, THE MITP SHALL BE MADE TO THE EXACT FLAT PATTERN DEVELOPMENT AT EACH EOP. THE RESULTANT BEVEL ANGLE CALLOUT AND FLANGE DEVELOPMENT AT EACH END OF MITP (5.00 BEYOND ACTUAL EOP) MUST BE PROPORTIONED TO ASSURE CORRECT BEVEL ANGLE AND FLANGE DIMENSIONS AT ACTUAL PART EOP'S.

METHOD 2: WHEN FLAT PATTERN DEVELOPMENT AT EACH END OF PART DIFFERS BY LESS THAN .05, THE ENTIRE MITP SHALL BE DEVELOPED TO THE LARGEST FLAT PATTERN DEVELOPMENT AND SHALL CALL OUT THE PROPORTIONED DEGREES EXISTING AT END OF MITP (5.00 BEYOND PART EOP).

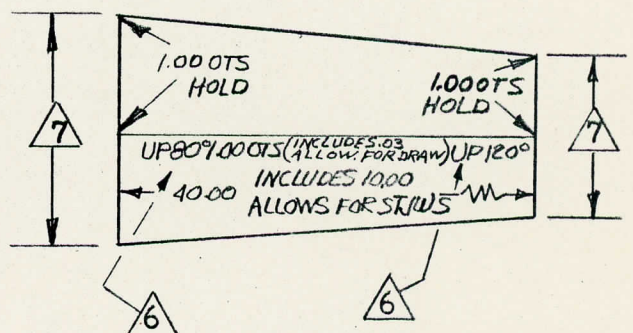
METHOD 3: WHEN VARYING BEVEL ANGLES RESULT IN AN IRREGULAR FLAT PATTERN DEVELOPMENT THAT VARIES OVER .03 FROM A STRAIGHT LINE, THE DEVELOPMENT SHOULD BE MADE OVERSIZE AND PART TRIMMED AFTER FORMING.

EXAMPLE FOR METHOD 1: PART 30.0 LONG, 1.00 FLANGES, .051 STOCK WITH .12R., 85° BEVEL ANGLE AT ONE END, AND 115° AT OTHER.

- 1 FLAT PATTERN OF PART.
- 2 LENGTH OF PART
- 3 LENGTH OF STOCK TO BE MADE PER MITP
- 4 MATERIAL ALLOWED FOR STJW'S (5.00 EACH END).
- 5 ACTUAL BEVEL ANGLE AT EOP.
- 6 PROPORTIONED BEVEL ANGLE AT END OF MITP.
- 7 PROPORTIONED DEVELOPMENT AT END OF MITP
- 8 DEVELOPMENT TO LARGEST AMOUNT



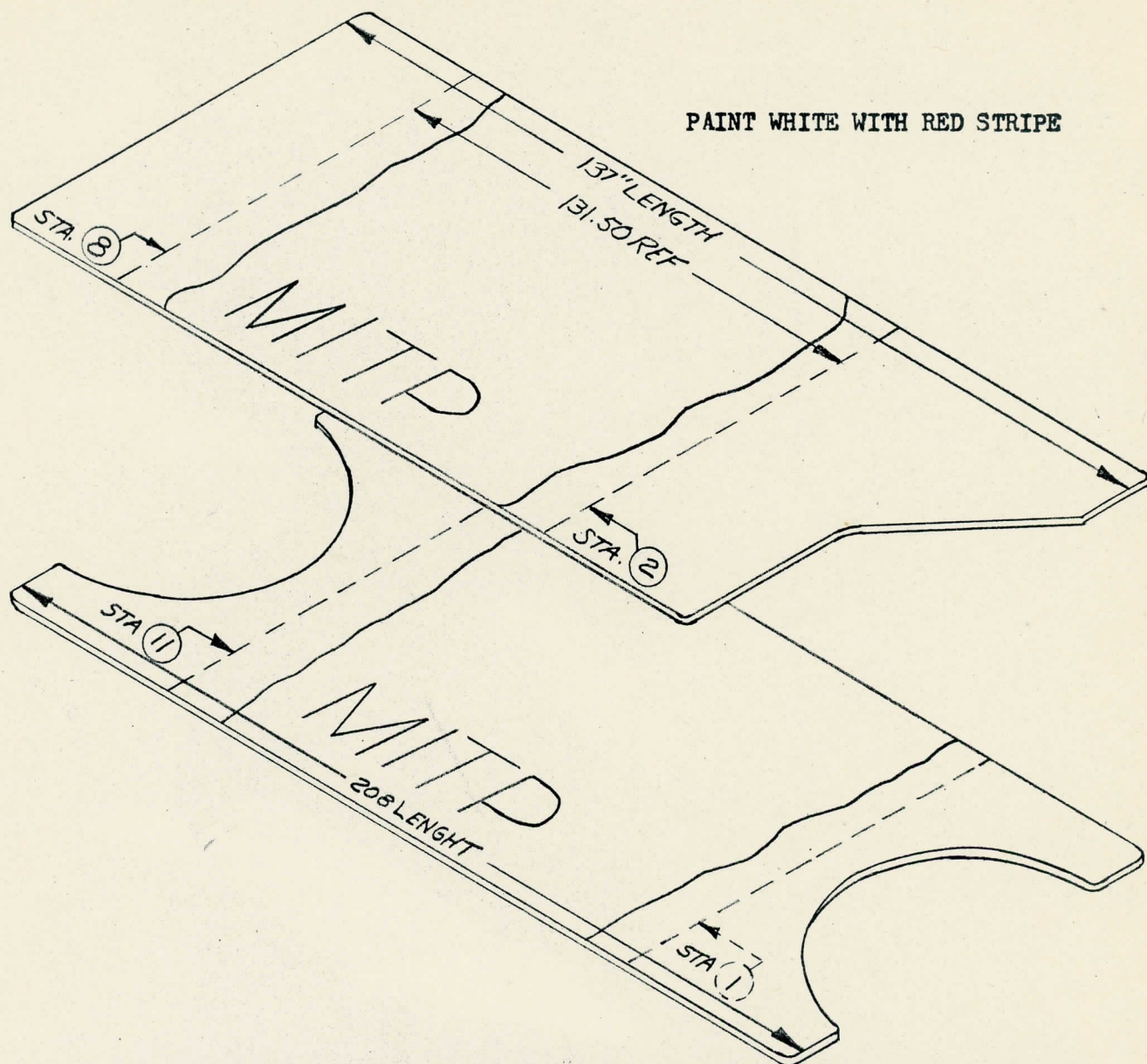
METHOD 2



METHOD 1

DRAWN	CAME 10-22-56	VARYING FLANGE DEVELOPMENT FOR MITP'S	TOOL FABRICATION PROCEDURES MANUAL	
CHECKED	ROBBINS 11-1-56			
APPROVED			<div>CONVAIR</div> <div>A DIVISION OF GENERAL DYNAMICS CORPORATION</div> <div>SAN DIEGO</div>	PAGE 35
APPROVED				





MINIATURE TEMPLATES ARE USED IN CASES WHERE PARTS ARE ESPECIALLY LARGE OR LONG AND ALL NECESSARY INFORMATION CAN BE GIVEN WITHOUT LAYOUT OF ENTIRE SIZE. - EXAMPLES ARE SHOWN.

TEMPLATES ARE USUALLY MADE TRUE WIDTH WITH A FORESHORTENED LENGTH; HOWEVER THEY MAY BE MADE WITH WIDTH AND LENGTH FORESHORTENED FOR SQUARE-SHEARED PARTS.

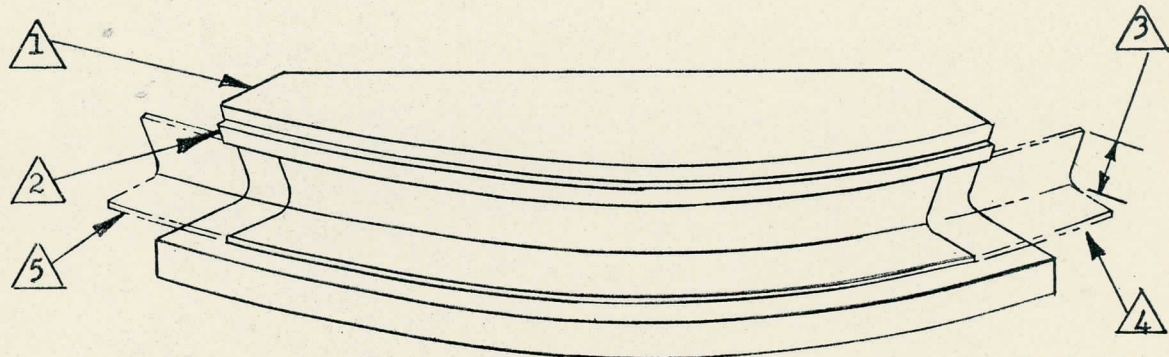
STENCIL MITP OR RUBBER STAMP MITP 2" LETTERS ON FACE OF TEMPLATE.

MAKE FROM TEMPLATE STOCK (#18 GAGE STEEL)

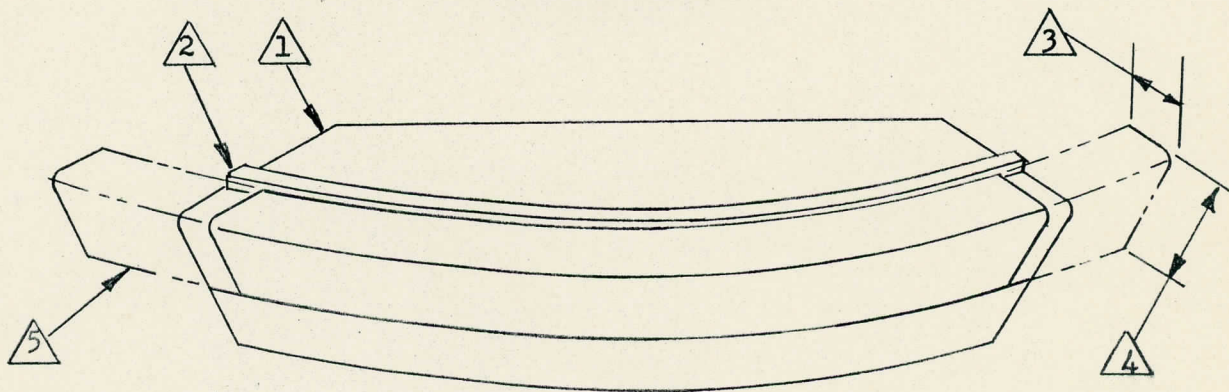
DRAWN	CAME 10-26-56	MINIATURE TEMPLATE "MITP" TOOL ILLUSTRATIONS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> SAN DIEGO	PAGE 36
APPROVED			



ALLOWANCES FOR MATERIAL DRAW ON MITP'S: ON "LEG-OUT" STRETCH AND WIPER FORMING, THE WIDTH OF THE OUTSTANDING FLANGE WILL BE REDUCED DUE TO MATERIAL DRAW, AS WILL ALSO BE THE DOWN FLANGE ON "LEG-IN" FORMING.



LEG OUT FORMING



LEG IN FORMING

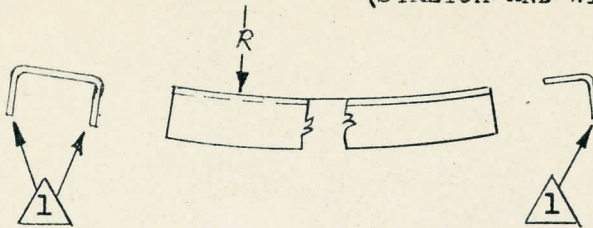
- |   |               |   |                               |
|---|---------------|---|-------------------------------|
| 1 | STFM          | 4 | DRAW TO BE ADDED              |
| 2 | BACK-UP STRIP | 5 | 5.00 ALLOW FOR STJMS EACH END |
| 3 | "HOLD" FLANGE |   |                               |

ALLOWANCES FOR MATERIAL DRAW ON STRETCH-FORMED OR WIPER FORMED PARTS MADE FROM FLAT STOCK: SHALL BE INCLUDED IN FLANGE DEVELOPMENTS.

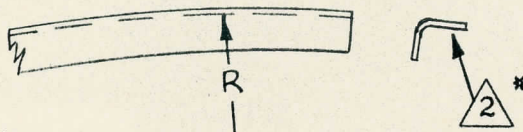
DRAWN	CAME 10-22-56	"ALLOWANCES FOR MATERIAL DRAW ON MITP'S"	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 10-25-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> <b>SAN DIEGO</b>	PAGE 37
APPROVED			



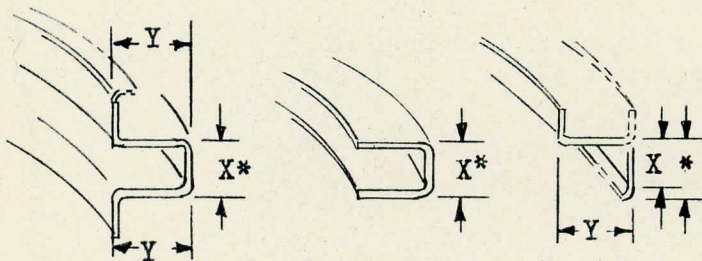
ALLOWANCES FOR DRAW - ALUMINUM & MAGNESIUM  
(STRETCH AND WIPER FORMED PARTS)



1 ON "LEG-OUT" ANGLES ADD .06 PER 1.00 OF FLANGE DIMENSION ON PARTS MADE FROM .072 OR LESS WHEN R IS UP TO 30.00 - WHEN R IS 30.00 OR MORE ON ALL GAUGES ADD .03 PER 1.00 FLANGE.



2 ON "LEG-IN" ANGLES ADD .06 ON PARTS MADE FROM .072 OR LESS WHEN R IS UP TO 6.00. WHEN R IS 6.00 OR MORE ON ALL GAUGES ADD .03.

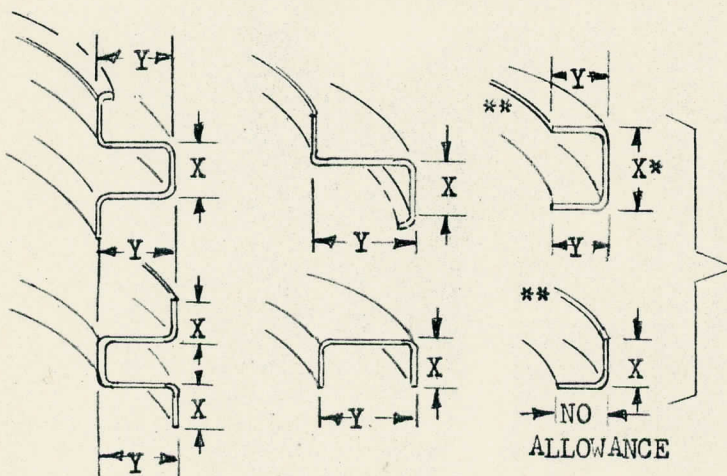


3 WHEN R IS GREATER THAN 8.00 ADD .03 TO "X" AND "Y" FLANGES ON ALL ZEES AND HAT SECTIONS, AND WEB OF CHANNELS.

4 WHEN R IS LESS THAN 8.00, ADD .03 TO "Y" FLANGE. ADD .09 TO "X" FLANGES OF .50 TO .75, AND .12 TO "X" FLANGES GREATER THAN .75.

\* NOTE: NO ALLOWANCE IS REQUIRED FOR WIPER FORMED "LEG-IN" PARTS.

ALLOWANCES FOR DRAW - TITANIUM & STAINLESS STEEL  
(STRETCH AND WIPER FORMED PARTS)



TO DETERMINE FLANGE LENGTHS INCLUDING ALLOWANCES FOR DRAW, (1) MULTIPLY "X" FLANGE DIMENSION BY 1.035 FOR GAUGES UP TO .025 OR BY 1.05 FOR GAUGES .025 AND OVER. (2) MULTIPLY "Y" FLANGE DIMENSION BY 1.018 FOR GAUGES UP TO .025 OR BY 1.025 FOR GAUGES .025 AND OVER.

\*NOTE: NO ALLOWANCE REQUIRED TO "X" FLANGE DIMENSION WHEN PART IS WIPER-FORMED.

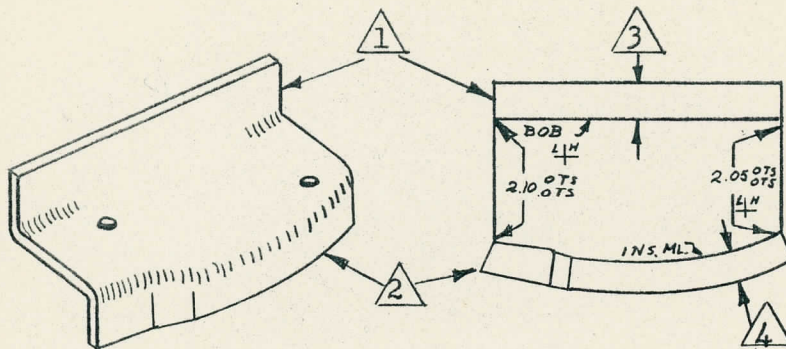
\*\*NOTE: THESE SHAPES CANNOT BE FORMED BY WIPER IF MADE FROM TITANIUM.

ALLOWANCES FOR DRAW SAME AS SHOWN FOR ALUMINUM & MAGNESIUM

DRAWN	CAME 10-22-56	ALLOWANCES FOR DRAW - ALUMINUM & MAGNESIUM (STRETCH AND WIPER FORMED PARTS)	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> <small>SAN DIEGO</small>	PAGE 38
APPROVED			



DEVELOPMENT FOR DUAL-TYPE FORMING: COMBINING BOB AND BLOCK FORMING OPERATIONS  
REQUIRES A COMBINATION OF BOTH TYPES OF DEVELOPMENT.

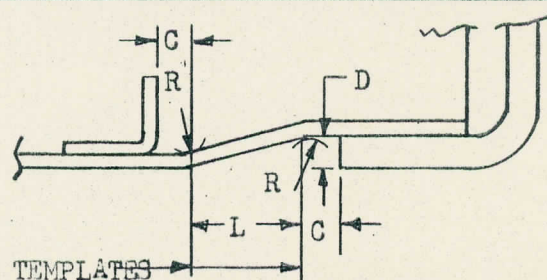


- 1 BRAKE FORMED FLANGE
- 2 BLOCK FORMED FLANGE
- 3 REFER TO "FLAT PATTERN DEVELOPMENT FOR BEND ON BRAKE"
- 4 REFER TO "FLAT PATTERN DEVELOPMENT FOR BLOCK FORMED PARTS"

STANDARD JOGGLE DATA:

M A T E R I A L	SHEETS HYDRO-PRESS OR BRAKE BEND			ROLLED (Y) SECTIONS		EXTRUDED (K) SECTIONS
	SOFT OR AN-NEALED AL	HEAT-TREATED OR COLD-WORKED AL				
	3003-0 2024-0 5052-0 7075-0	2024-T4 2024-T4 CLAD 6061-T4 7075-T6 7075-T6 CLAD	T1* MAG*	2024-T4 2024-T3 7075-W	7075-T6 MAG	ALL MAT'L'S
L	3D	4D	4D	4D	6D	6D
C	.12 (FOR GAGES UP TO & INC. .102) .20 (FOR GAGES .125 TO .188)			.12		.12

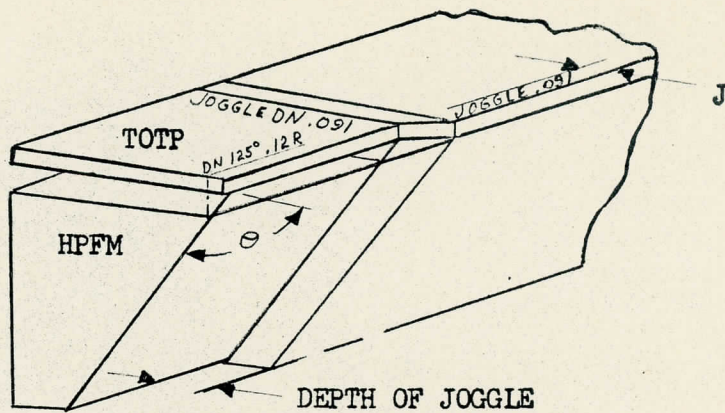
\* ALL T1 & MAG VALUES INDICATED ARE HOT FORMED  
R = RADII TO BE EQUAL OR GREATER THAN STANDARD BEND RADII FOR GAGE MAT'L USED.



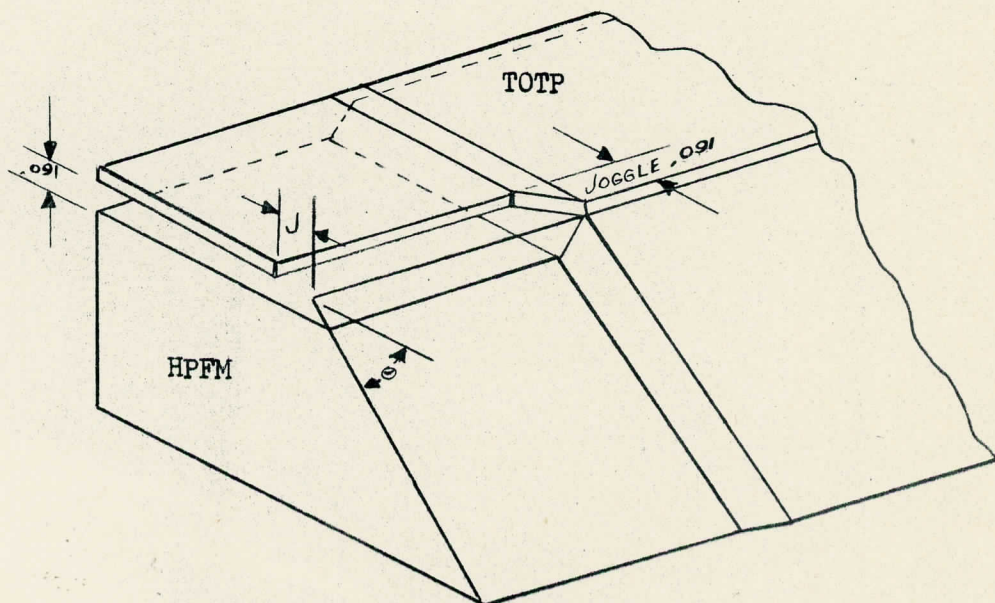
THESE LINES TO BE SHOWN ON TEMPLATES

DRAWN	CAME 10-24-56	DEVELOPMENT FOR DUAL TYPE FORMING & STANDARD JOGGLE DATA	TOOL FABRICATION PROCEDURE MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 39
APPROVED			





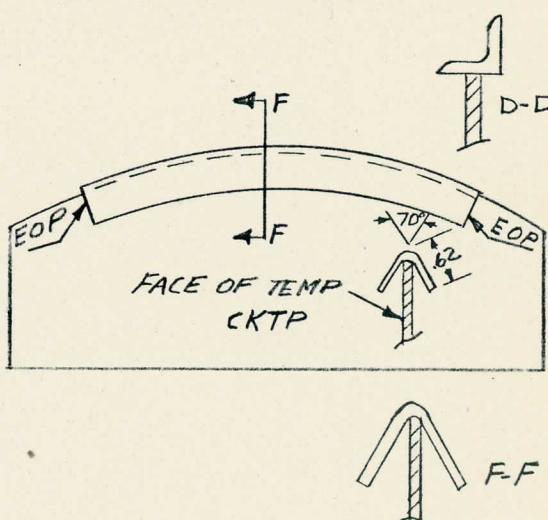
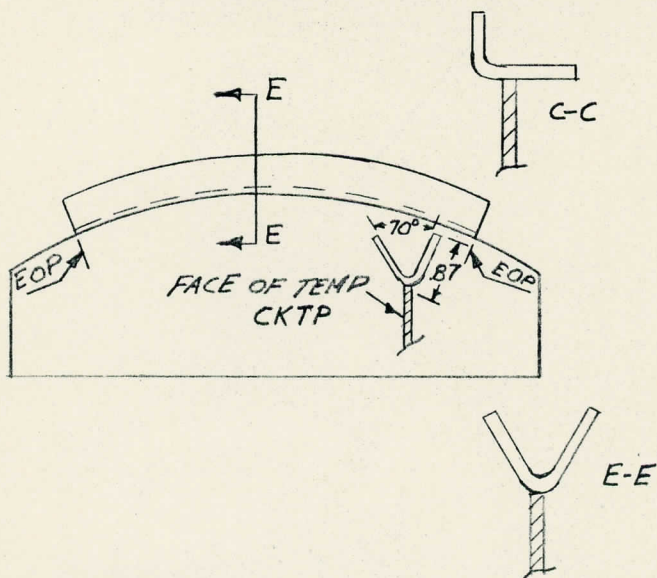
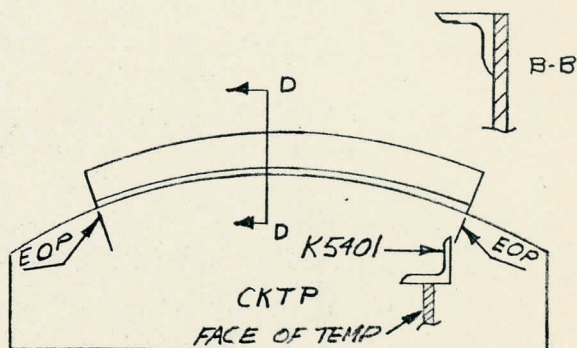
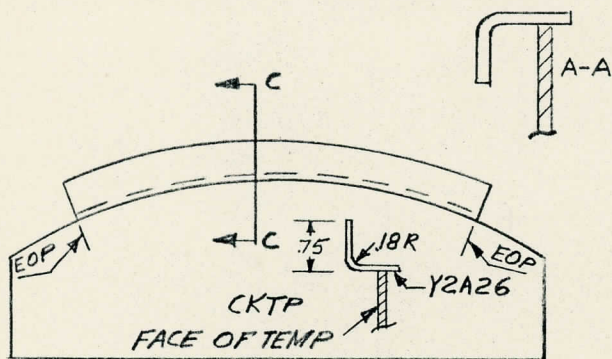
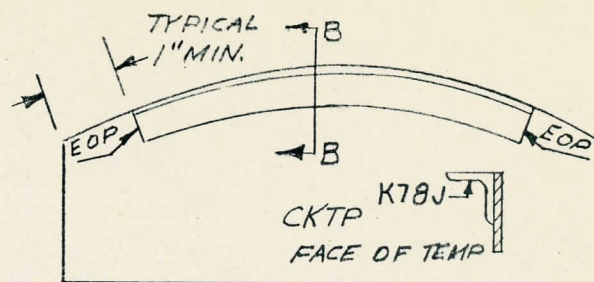
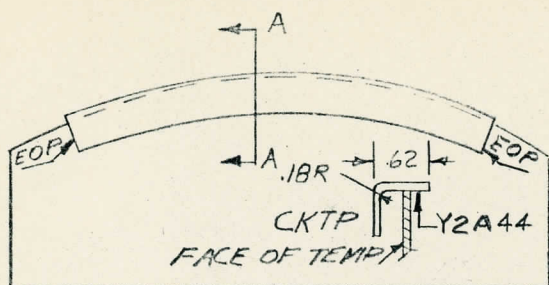
$$J = \text{SEC. 8 X DEPTH OF JOGGLE}$$



$$J = \text{SEC. 8 X DEPTH OF JOGGLE}$$

DRAWN	CAME 11-1-56	DOUBLE JOGGLES HYDRO PRESS FORM	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-10		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 40
APPROVED			





#### CKTP NOTES:

CKTP'S ARE TO BE MADE MALE UNLESS OTHERWISE SPECIFIED OR PRACTICAL.

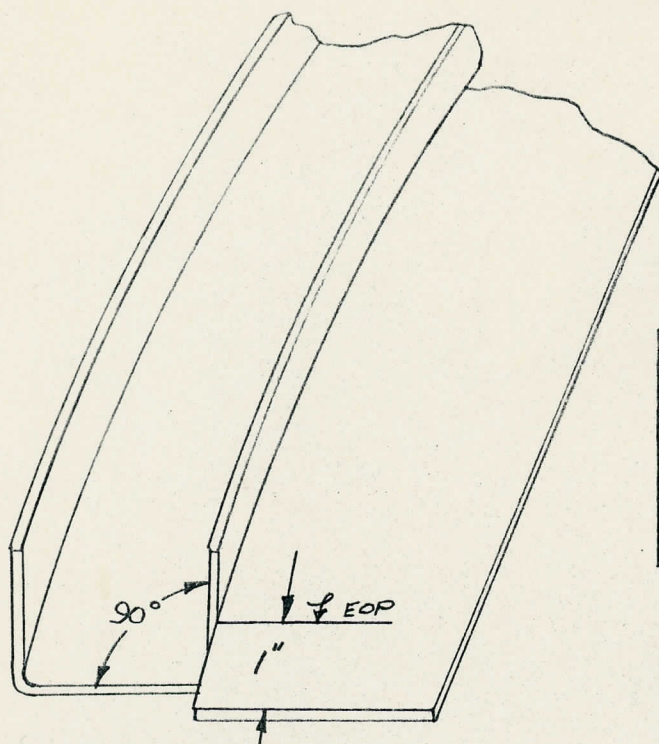
THE ANGLE OF THE BEND SHOULD BE CALLED OUT ON CKTP'S.  
RADIUS AND FLANGE LENGTH SHOULD BE CALLED OUT ON CKTP'S.  
MATERIAL AND GAGE OF SHEET STOCK SHALL BE CALLED OUT ON CKTP  
INCLUDING "Y" AND "K" SECTIONS.

A SKETCH IS REQUIRED ON ALL CKTP'S TO SHOW APPLICATION OF TEMPLATE TO PART.  
D/C (DRAWING CHANGE)

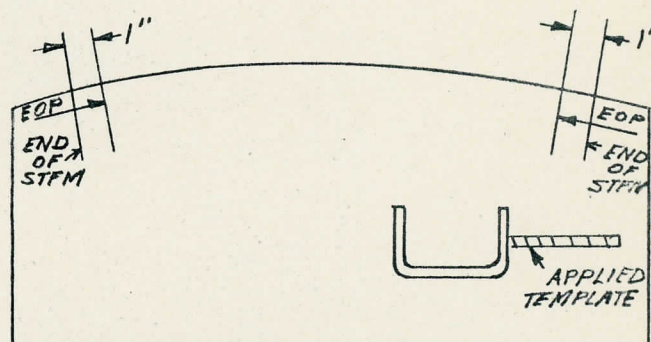
DRAWN	CAME 10-25-56	CHECK TEMPLATE "CKTP" TOOL ILLUSTRATION (MALE ILLUSTRATED)	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 45
APPROVED			



## TOOL LOFT PROCEDURE



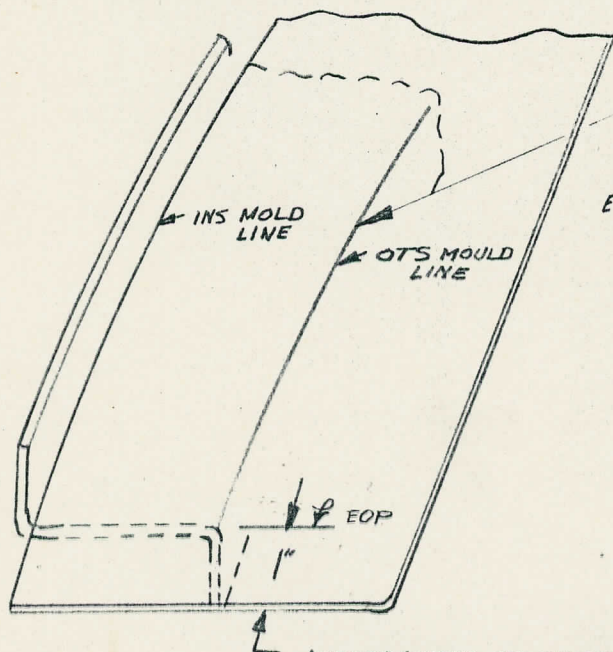
APPLICATION OF TEMPLATE NO. 1



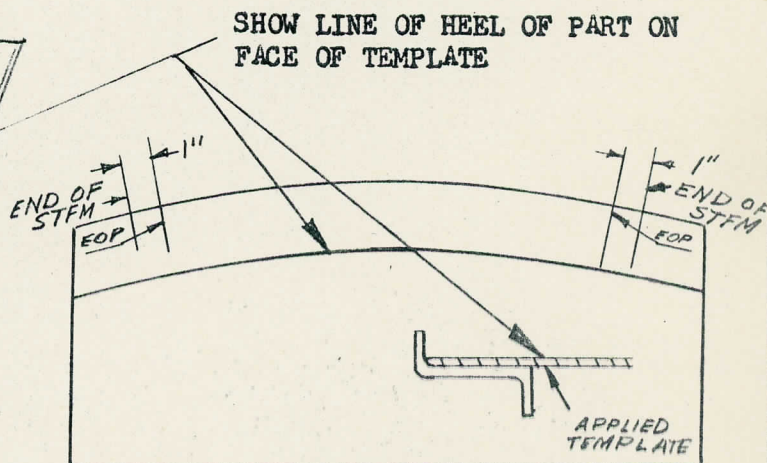
TEMPLATE NO. 1

MAKE CKTP TO APPLY MALE UNLESS OTHERWISE NOTED.

CKTP ALSO USED TO FAB STFM.



APPLICATION OF TEMPLATE NO. 2



TEMPLATE NO. 2

DRAWN	CAME 10-30-56
CHECKED	ROBBINS 11-1-56
APPROVED	
APPROVED	

CKTP FOR STRETCHER FORM

**CONVAIR**

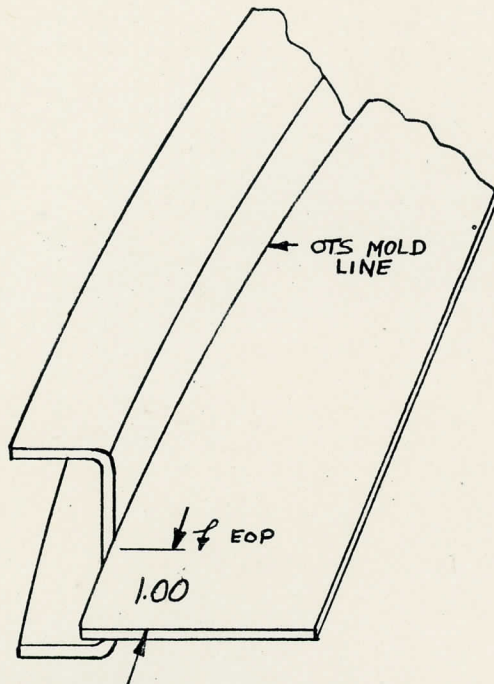
A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO

TOOL FABRICATION  
PROCEDURES  
MANUAL

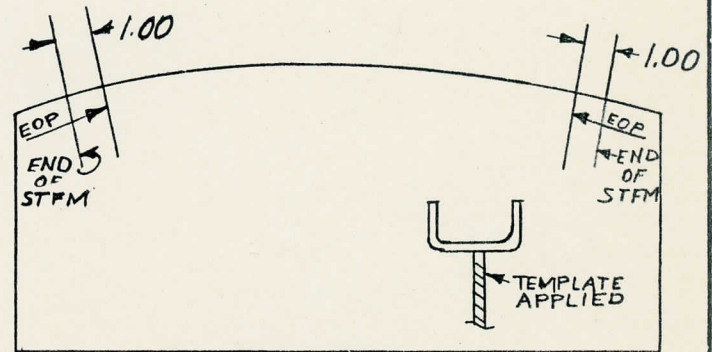
PAGE 46



# TOOL LOFT PROCEDURE

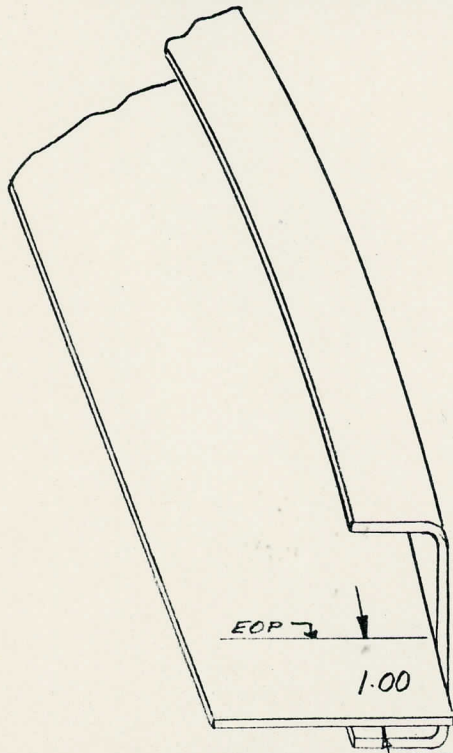


APPLICATION OF TEMPLATE NO. 3

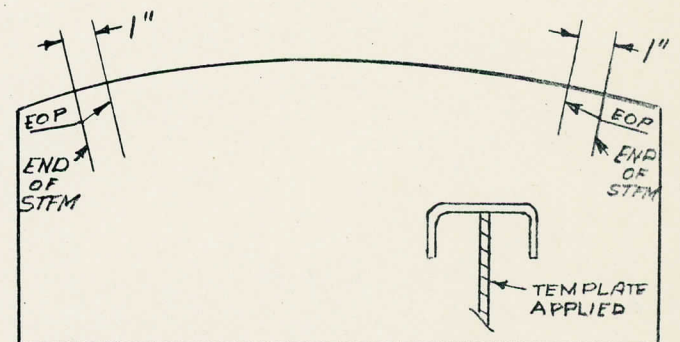


TEMPLATE NO. 3

CKTP ALSO USED TO FABRICATE STFM



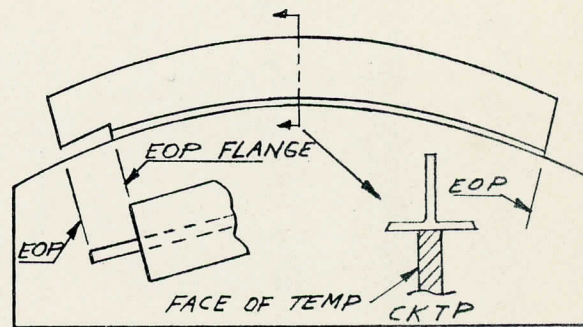
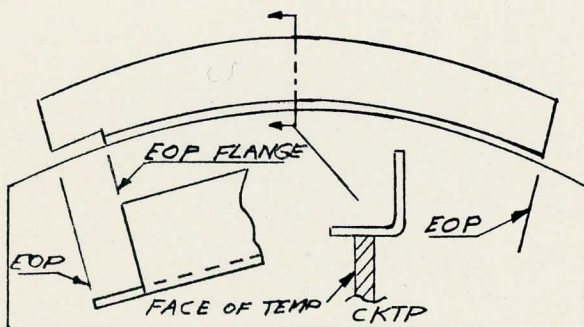
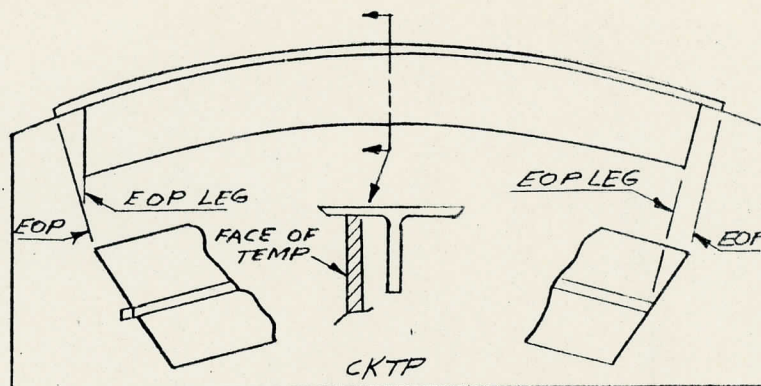
APPLICATION OF TEMPLATE NO. 4



TEMPLATE NO. 4

DRAWN	CAME 10-30-56	CKTP FOR STRETCHER FORM	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 47
APPROVED			

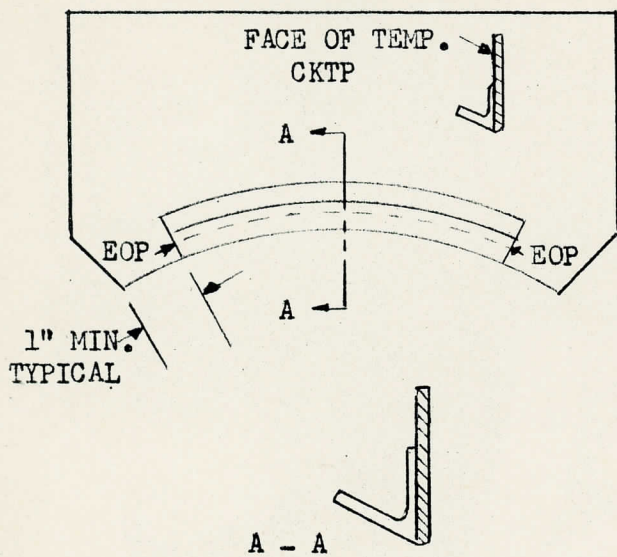




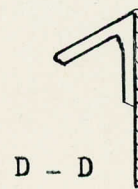
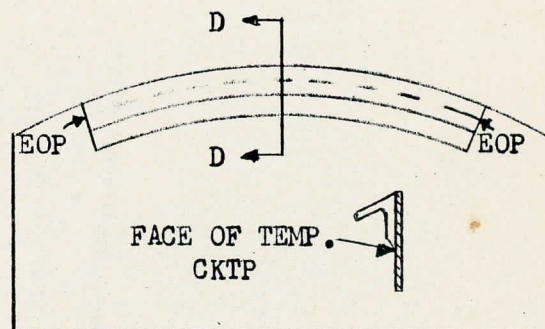
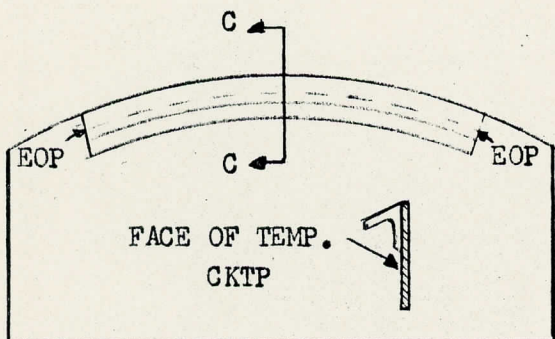
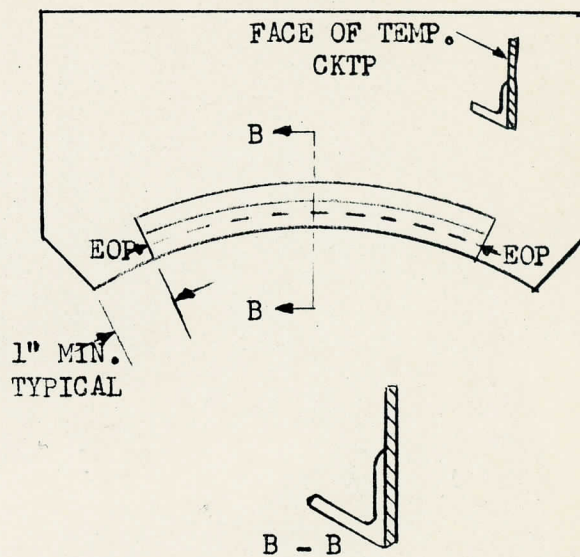
DRAWN	CAME 10-24-56	TOOL ILLUSTRATIONS CHECK TEMPLATE	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> SAN DIEGO	PAGE 48
APPROVED			



# "Y" SECTIONS



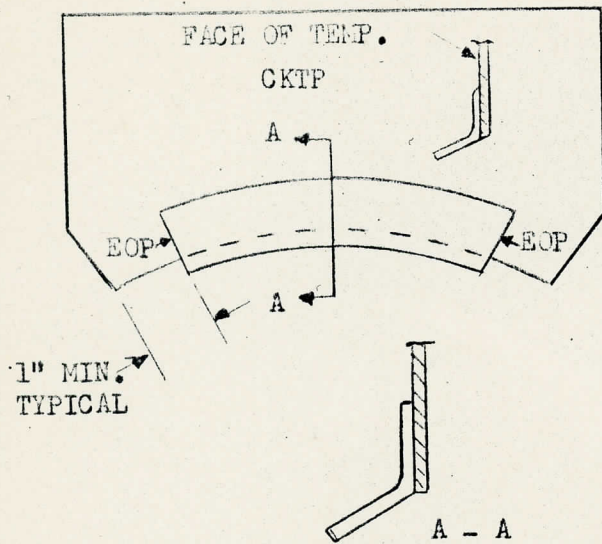
# "K" SECTIONS



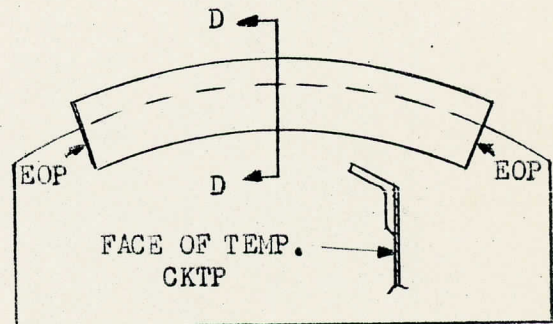
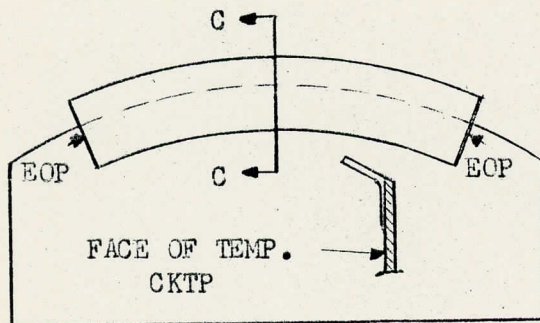
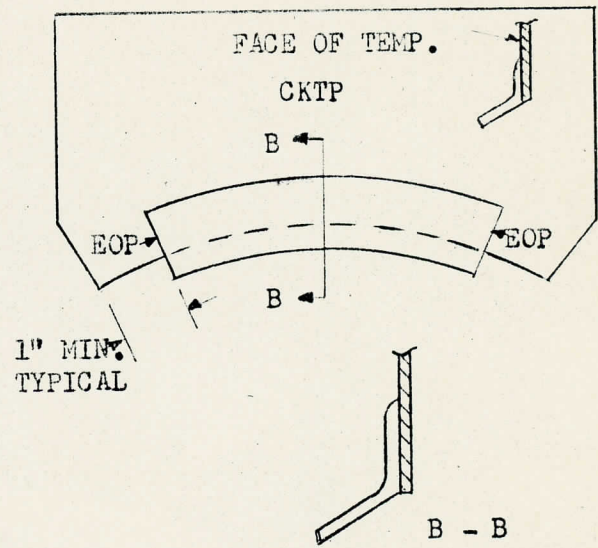
DRAWN	CAME 11-1-56	TOOL ILLUSTRATIONS CHECK TEMPLATE	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-10		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 49
APPROVED			



# "Y" SECTIONS



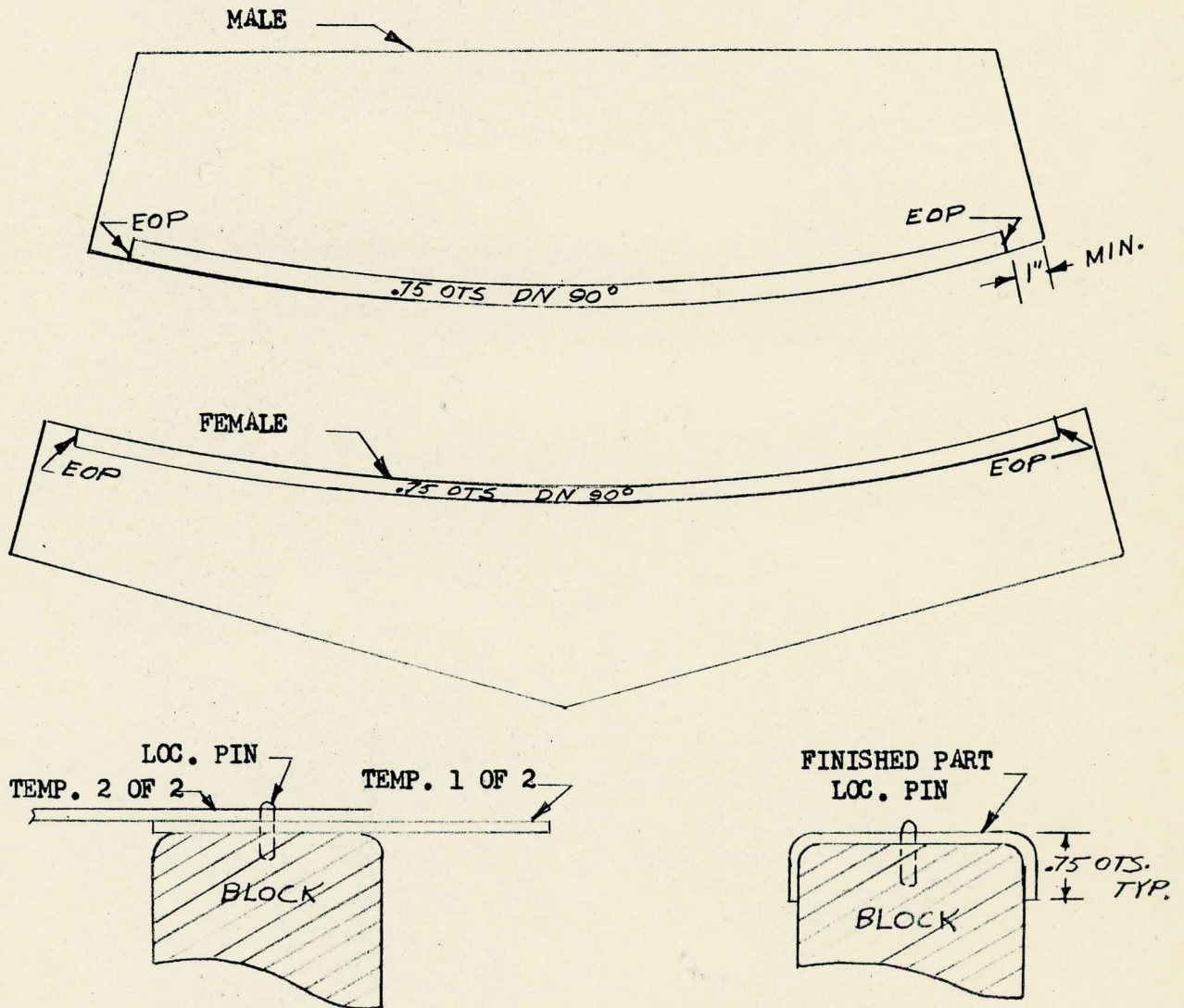
# "K" SECTIONS



DRAWN	CAME 11-1-46	TOOL ILLUSTRATIONS CHECK TEMPLATES	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-10		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> <small>SAN DIEGO</small>	PAGE 50
APPROVED			



# TOOL LOFT PROCEDURE

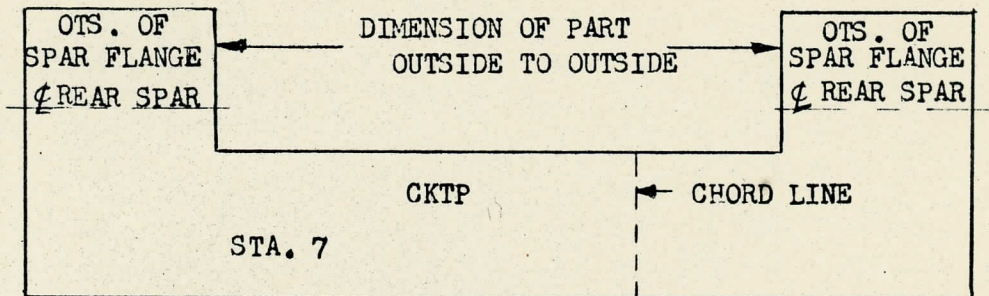


EXAMPLE OF A TWO PART CKTP USED FOR LONG NARROW MEMBERS. LOCATING HOLES MUST COORDINATE.

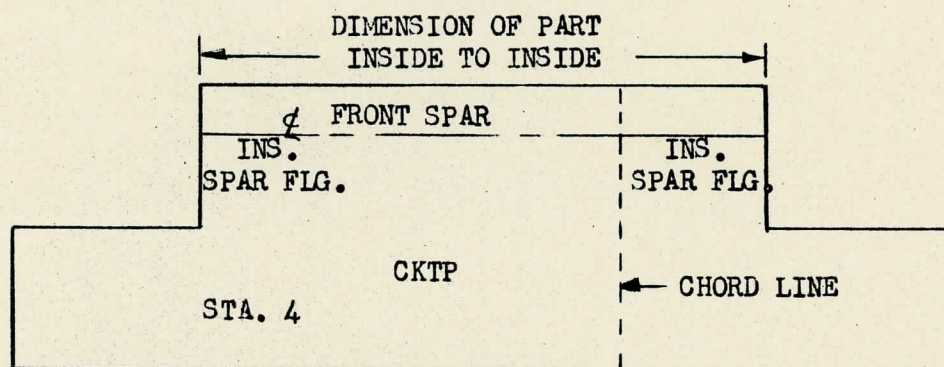
CKTP ALSO USED TO FABRICATE STFM.

DRAWN	CAME 10-30-56	CKTP FOR LONG NARROW MEMBERS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> <small>SAN DIEGO</small>	PAGE 51
APPROVED			

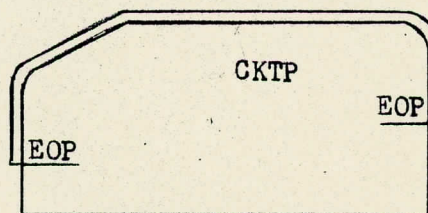
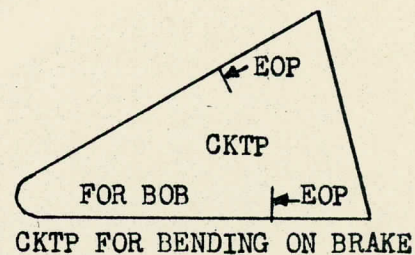
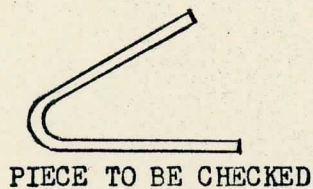




OUTSIDE



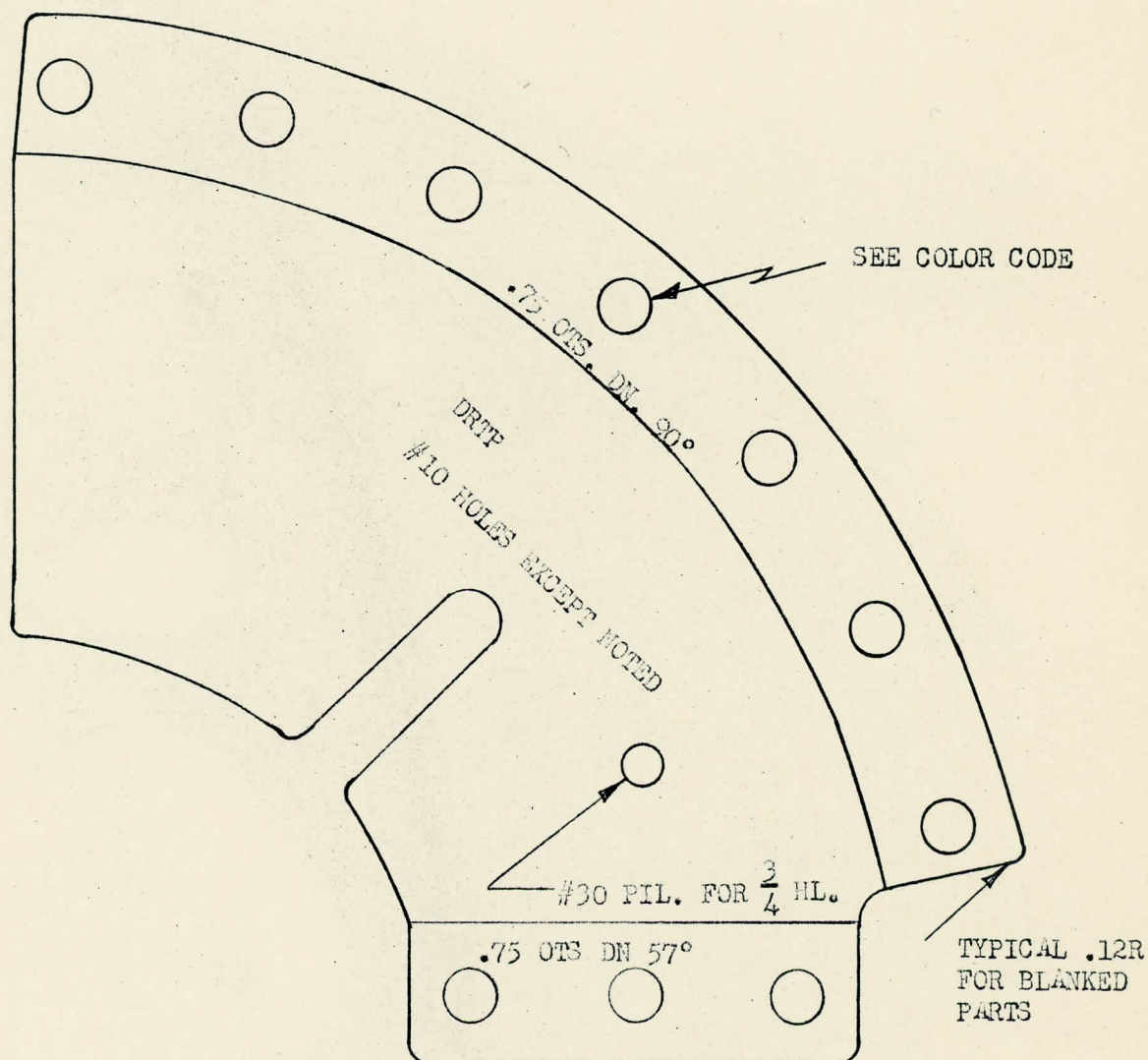
INSIDE



EXAMPLE OF THREE BEND CKTP

DRAWN	CAME 11-1-56	CHECK TEMPLATE TOOL ILLUSTRATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-10-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 52
APPROVED			



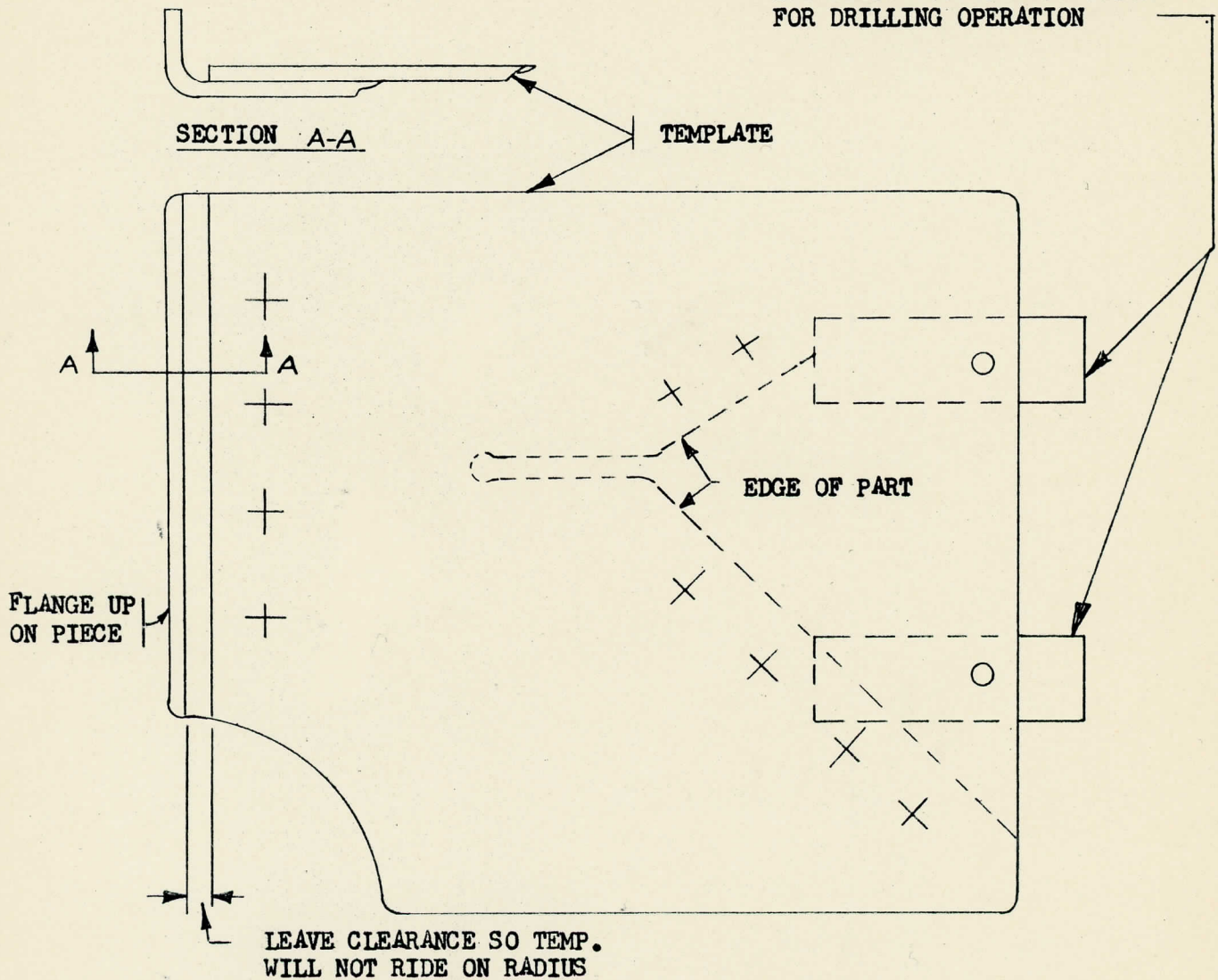


HOLES IN DRILL TEMPLATES ARE ADAPTER SIZE TO ALLOW FOR ADAPTER BUSHINGS (SEE STANDARD HOLE CHART).

DRAWN	CARE 10-24-56	TOOL ILLUSTRATION - DRILL TEMPLATE	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> <b>SAN DIEGO</b>	PAGE 57
APPROVED			



BLOCKS WITH PINS FOR SECURING DRTP TO PROPER POSITION FOR DRILLING OPERATION



REF. STD. COLOR CODE FOR HOLES

PART TO BE DRILLED AND ASSEMBLED ON ASSEMBLY FIXTURE.

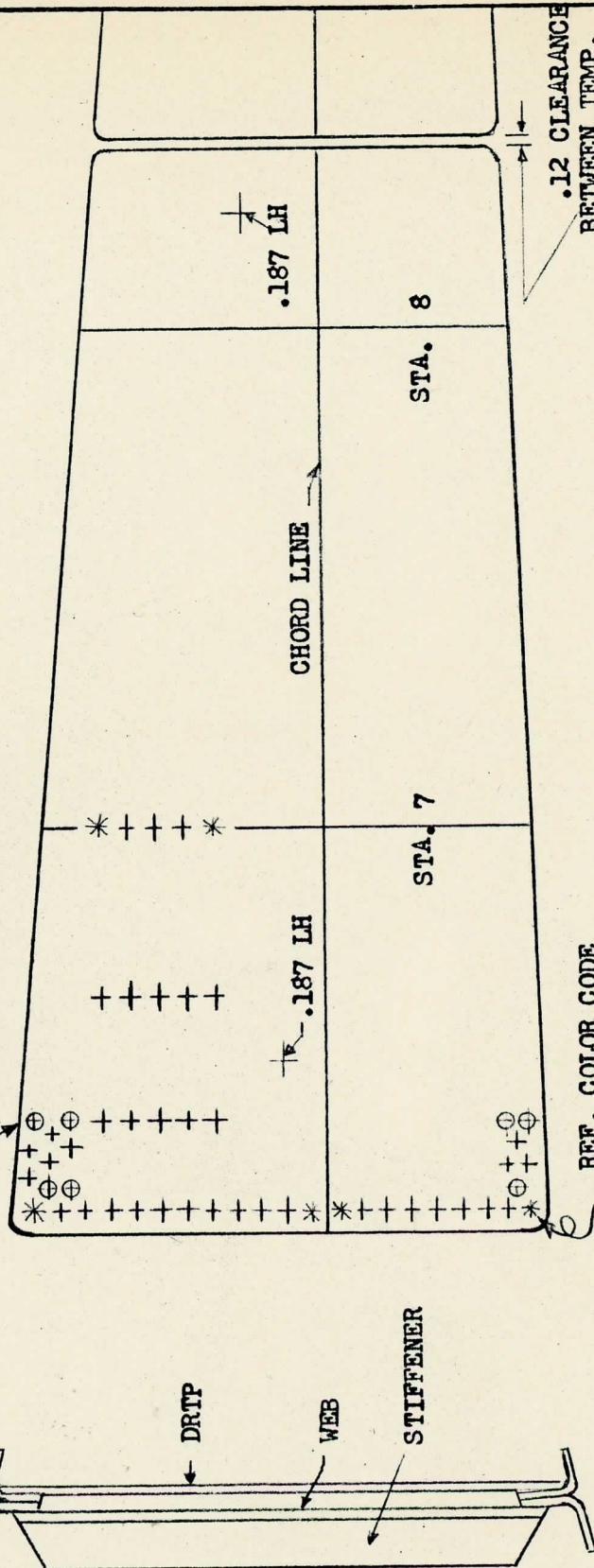
**NOTE:** WHEN THE WEB TEMPLATE HAS LOCATING HOLES THE DRTP LOCATING HOLES SHOULD BE COORDINATED WITH THEM. DRTP LOCATING HOLES ARE ACTUAL SIZE.

DRAWN	CAME 10-25-56	TOOL ILL. DRTP FOR ASSEMBLY FIXTURE	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> SAN DIEGO	PAGE 58
APPROVED			



SPAR FLANGES

FOR HOLE SIZE  
REF. TO HOLE SIZE CHART



THIS TYPE OF DRTP IS OFTEN USED IN CONJUNCTION WITH ASSY. FIXTURES THE CHORD LINE IS ALWAYS SHOWN AND STATION CENTER LINE IF NECESSARY. CLEARANCE OF RADIUS ON SPAR FLANGES IS IMPERATIVE, LOCATING HOLES MUST BE COORDINATED WITH DRTP. RIVET SIZE MAY BE CALLED OUT BY LOFTSMAN AS SHOWN TO AID IN PUNCHING HOLES ACCURATELY. (THIS TEMP. IS PHOTOGRAPHIC REPRODUCTION) MAKE FROM TEMP. STOCK (18 GAUGE STEEL)

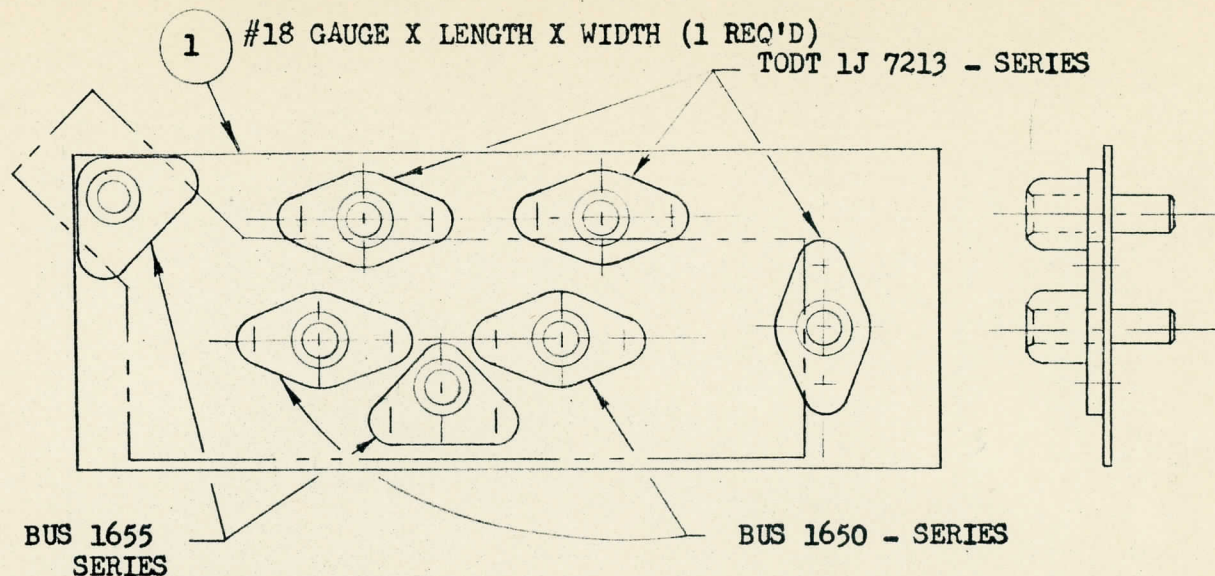
DRAWN	CAME 10-25-56
CHECKED	ROBBINS 11-1-56
APPROVED	
APPROVED	

TOOL ILL. DRTP FOR DRILLING PARTS ON ASFX

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A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO

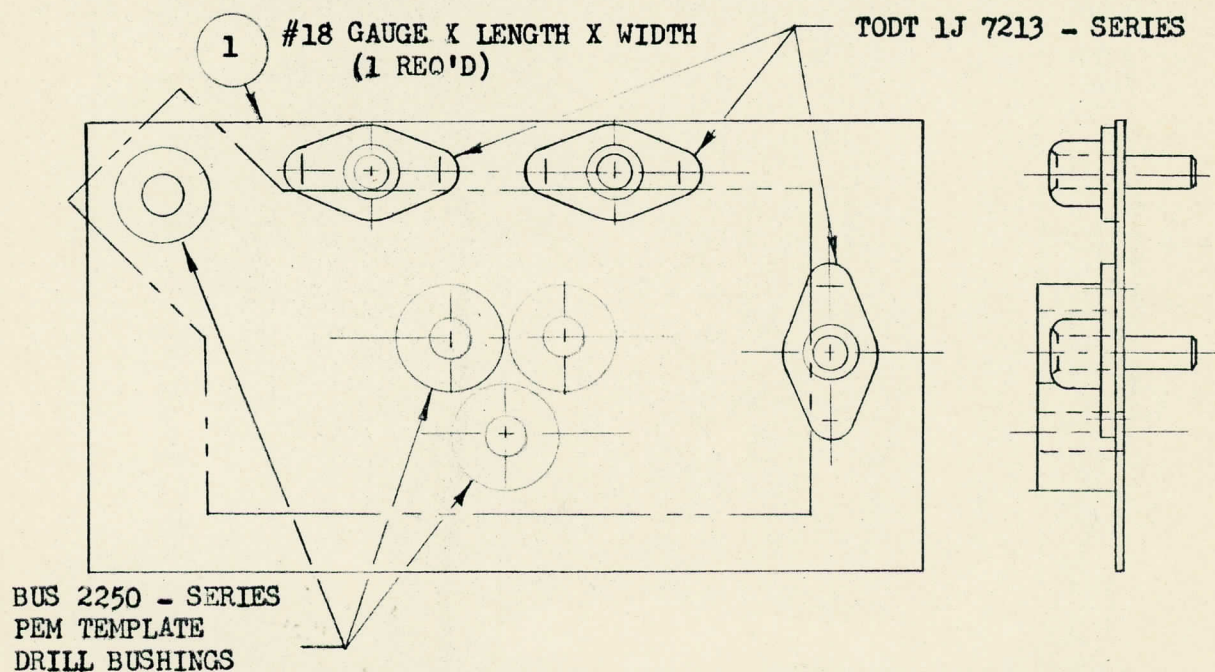
TOOL FABRICATION PROCEDURES MANUAL
PAGE 59





#### METHOD OF APPLICATION

1. PIERCE HOLES IN #18 GAUGE STEEL (HOLES MUST BE P.F. FOR BUSHINGS) - REF. "D<sub>1</sub>" DIM.
2. PRESS IN BUSHINGS AND SPOTWELD OR FLUSH RIVET ANCHOR NUTS TO STEEL SHEET.
3. FOR CONTOUR DRPE'S, FORM TABS ON ANCHOR NUTS TO CONTOUR.
4. SEE FOLLOWING PAGES

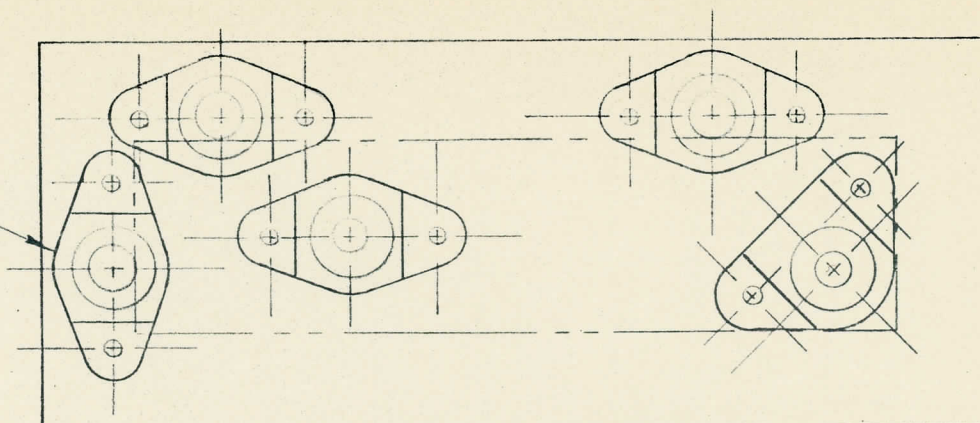


1. PIERCE HOLES IN #18 GAUGE STEEL (HOLES MUST BE P.F. FOR BUSHINGS) - REF. - "B" DIM.
2. PRESS IN BUSHINGS DEEP ENOUGH TO UPSET METAL AROUND HOLE TO LOCK IN STEEL SHEET.
3. SEE FOLLOWING PAGES.

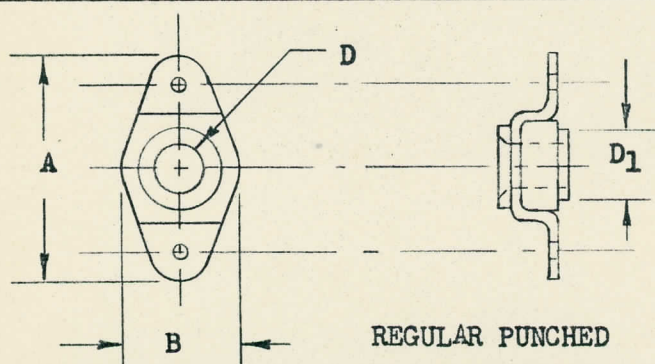
DRAWN	CAME 10-25-56	DRILL PLATE WITH ANCHOR AND PEM TYPE DRILL BUSHINGS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> SAN DIEGO	PAGE 60
APPROVED			



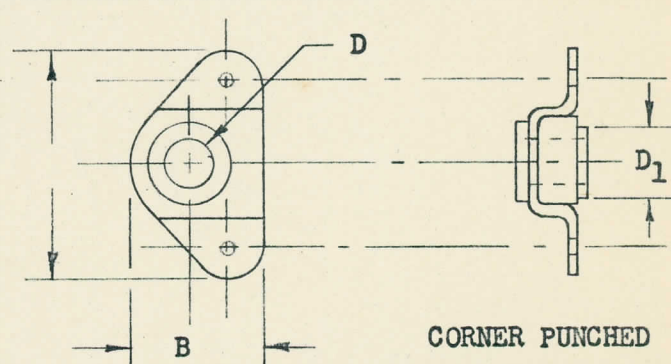
TODT 1J 7213  
LOC. DWL.  
(REF.)



TYP. APPLICATION (NO SCALE)



REGULAR PUNCHED



CORNER PUNCHED

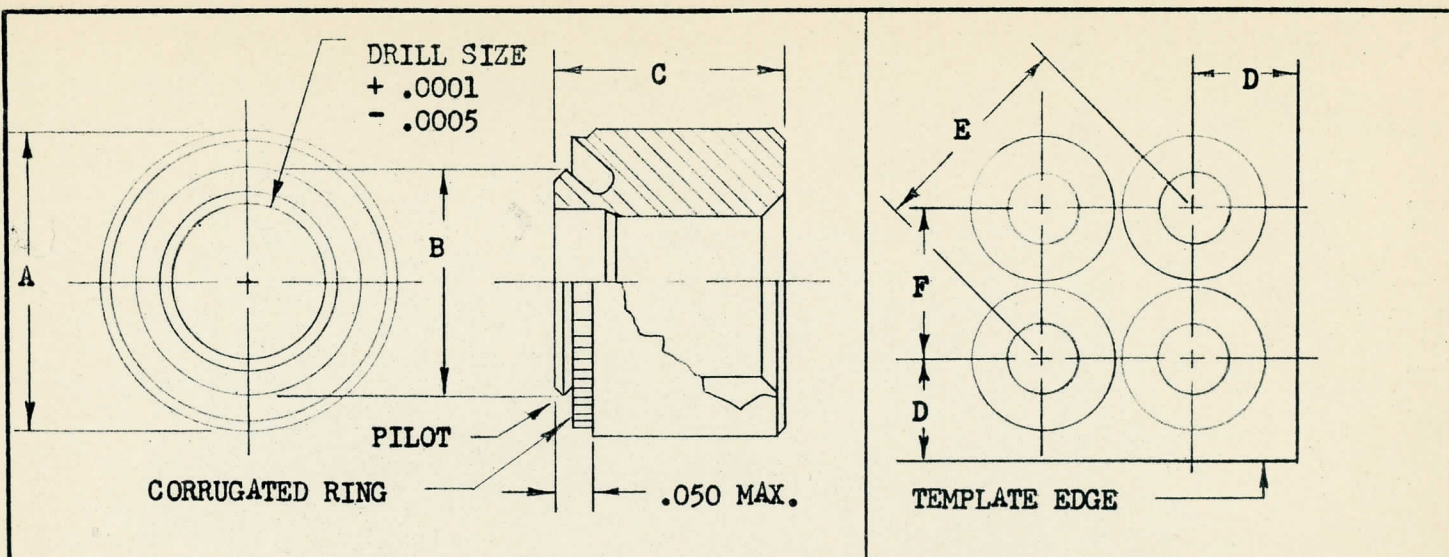
DRILL SIZE D	TEMP HOLE SIZE D <sub>1</sub>	REGULAR PUNCHED			CORNER PUNCHED		
		CVAC NO.	A	B	CVAC NO.	A	B
.0670	.250	BUS 1650-10	1.06	.40	BUS 1655-5	1.06	.59
.0995		BUS 1650-15			BUS 1655-15		
.1285							
.1470							
.1610	.375	BUS 1650-25	1.25	.62	BUS 1655-25	1.25	.694
.1695		BUS 1650-30			BUS 1655-35		
.1910		BUS 1650-35					
.2130		BUS 1650-40					
.2280		BUS 1650-45					
.2500		BUS 1650-50					
.2570		BUS 1650-55					
.2810		BUS 1650-60					
.3125	.562	BUS 1650-65	1.47	.81		1.47	.885

METHOD OF APPLICATION

1. PIERCE HOLES IN #18 GAUGE STEEL
2. SPOTWELD OR RIVET ANCHOR BUSHING TO STEEL SHEET.
3. FOR CONTOURED DRPE'S, FORM TABS ON ANCHOR BUSHING TO CONTOUR.

DRAWN	CAME 10-25-56	ANCHOR DRILL BUSHINGS & LOC. DOWEL FOR USE ON DRPE'S	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 61
APPROVED			





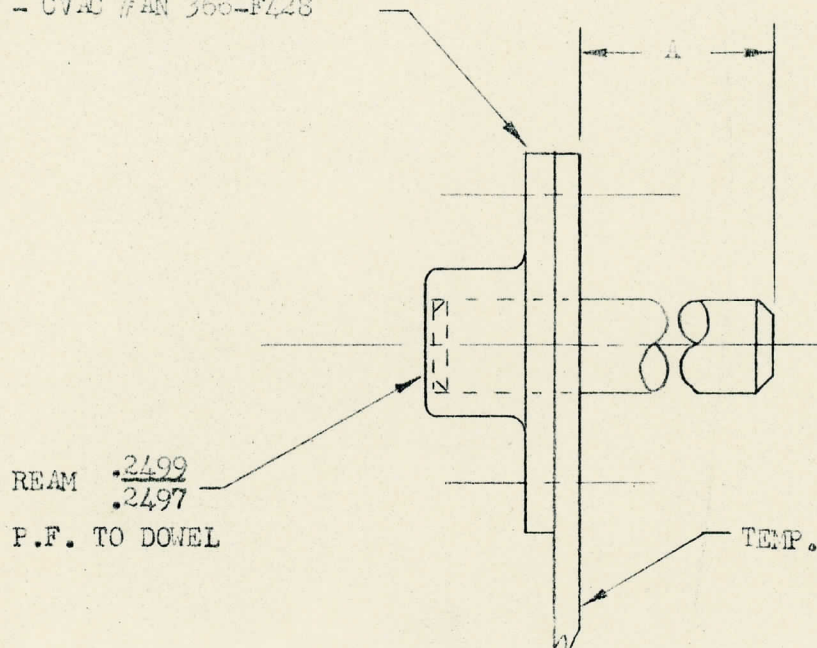
# MINIMUM PATTERN AND EDGE DISTANCE

DRILL SIZE	TEMP. HOLE SIZE +.002 -.000	A	B +.003 -.000	C	D	E	F	MFG'S TYPE #	CVAC # BUS 2250
.0670	.250	.38	.252	.34	.25	.53	.38	P B 0	2250
.0995	.250	.38	.252	.34	.25	.53	.38	P B 0	2250 - 35
.1285	.250	.38	.252	.34	.25	.53	.38	P B 0	2250 - 5
.1470	.375	.50	.377	.38	.38	.72	.50	P B 1	2250 - 45
.1610	.375	.50	.377	.38	.38	.72	.50	P B 1	2250 - 10
.1695	.375	.50	.377	.38	.38	.72	.50	P B 1	2250 - 50
.1850	.375	.50	.377	.38	.38	.72	.50	P B 1	2250 - 55
.1910	.375	.50	.377	.38	.38	.72	.50	P B 1	2250 - 15
.2130	.375	.50	.377	.38	.38	.72	.50	P B 1	2250 - 60
.2280	.375	.50	.377	.38	.38	.72	.50	P B 1	2250 - 65
.2500	.375	.50	.377	.38	.38	.72	.50	P B 1	2250 - 30
.2570	.375	.50	.377	.38	.38	.72	.50	P B 1	2250 - 40
.2810	.562	.68	.564	.50	.56	.97	.68	P B 2	2250 - 70
.3125	.562	.68	.564	.50	.56	.97	.68	P B 2	2250 - 75

DRAWN	CAME 10-25-56	<p>PEM TEMPLATE DRILL BUSHINGS</p> <p><b>CONVAIR</b></p> <p>A DIVISION OF GENERAL DYNAMICS CORPORATION</p> <p>SAN DIEGO</p>	<p>TOOL FABRICATION PROCEDURES MANUAL</p> <p>PAGE 62</p>
CHECKED	ROBBINS 11-1-56		
APPROVED			
APPROVED			



USE - CVAC #AN 366-F428



1J 7213 LOCATING DOWEL

DASH NO.	A
-1	.06
-2	.12
-3	.25
-4	.50

DRAWN	CATE 10-21-56	LOCATING DOWEL	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
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APPROVED			



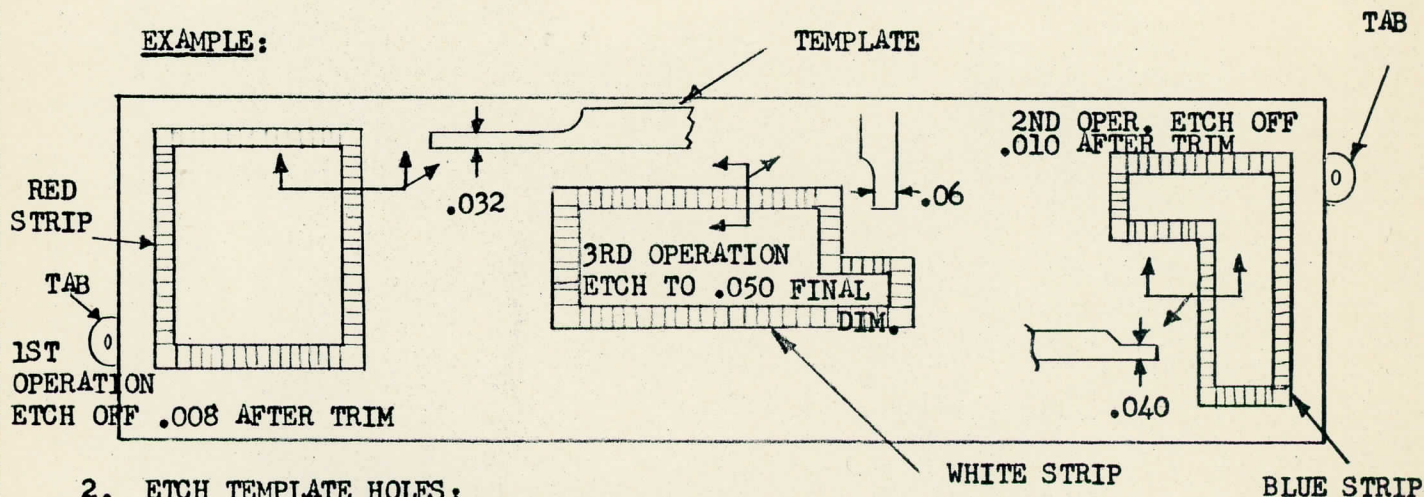
## ETCH TEMPLATE

ETCH TEMPLATE IS A TOOL USED IN TRIMMING THE MASKING ON PARTS PRIOR TO CHEMICAL ETCHING. THE TOOL WILL MATCH THE INTERIOR OR EXTERIOR CURVATURE OF THE PART AND WILL CONTAIN COORDINATED LOCATING HOLES. THE INTERIOR AND/OR EXTERIOR EDGES OF THIS TOOL EXACTLY LOCATE THE LINES WHERE THE MASK IS TO BE TRIMMED. THE EDGES OF THE TOOL WILL BE COLOR CODED TO INDICATE SEQUENCE OF TRIMMING OPERATION, AND WILL INCORPORATE ALLOWANCE FOR EAT BACK ON PART DURING THE ETCHING.  
ETTP - WILL BE PAINTED BLACK.

1. COLOR CODE: WHEN MORE THAN ONE ETCH OPERATION IS TO BE USED THE FOLLOWING COLOR CODE IS RECOMMENDED.

(a) RED	1ST OPERATION	(e) GREEN	5TH OPERATION
(b) BLUE	2ND OPERATION	(f) ORANGE	6TH OPERATION
(c) WHITE	3RD OPERATION	(g) GRAY	7TH OPERATION
(d) YELLOW	4TH OPERATION		

A STRIP PAINTED ALONG THE AREA TO BE ETCHED SHOWING SECTIONAL VIEW OF FINAL DEPTH. IN ADDITION, EACH AREA WILL BE CLEARLY STAMPED TO INDICATE WHEN IT IS TO BE USED AND WILL CALL OUT AMOUNT TO BE ETCHED FROM AREA AFTER MASKING IS TRIMMED. THE FIRST OPERATION WILL BE THE DEEPEST ETCHED AREA, SECOND OPERATION SECOND DEEPEST AND SO ON.



2. ETCH TEMPLATE HOLES:

- .250 ACTUAL SIZE HOLES IN "ETTP"
- LOCATION OF "ETTP" HOLES TO BE DETERMINED BY TEMPLATE SHOP.
- EDGE DISTANCE TO BE AT LEAST .30 FROM CENTER OF HOLE TO E.O.P. OF PART OR EDGE OF TAB.
- HOLES TO BE FOOLPROOF.
- HOLES TO BE COORDINATED TO THE DRILLING TOOL SUCH AS "DRTP", "DRSH", ETC.
- ONE SET OF HOLES WILL BE USED FOR ALL ETCH TEMPLATES REQUIRED FOR A PART.

DRAWN	CAME 11-1-56	ETCH TEMPLATE DATA	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 68
APPROVED			



### 3. TRIM

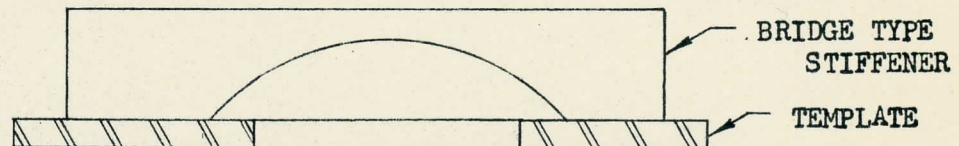
- (a) ON LARGE PARTS THAT HAVE MORE THAN ONE FLANGE OR COMPOUND CONTOUR, WHERE A ROUTER FORM WOULD BE IMPRACTICAL NO TRIM SHOULD BE ALLOWED, EXCEPT FOR TABS FOR "ETTP" HOLES.
- (b) ON DOORS, DOUBLERS, FLAT PARTS AND SIMPLE CONTOURS AT LEAST 1/2 INCH TRIM SHOULD BE ALLOWED.

### 4. TOOL DESIGN:

- (a) TOOL DESIGN REQUIRED ONLY ON CLOSE TOLERANCE PARTS, SUCH AS, DOORS, AND DOUBLERS OR CLOSE COORDINATION PARTS.
- (b) NO TOOL DESIGN REQUIRED ON FRAMES.

### 5. MANUFACTURE OF TEMPLATES:

- (a) STIFFENERS ACROSS ETCHED AREAS TO BE REMOVABLE OR BRIDGE TYPE, SUCH AS:



THESE STIFFENERS SHALL BE PLAINLY STAMPED "STIFFENERS ONLY".  
STIFFENERS TO BE KEPT TO A BARE MINIMUM.

- (b) WHEN A FORMED TEMPLATE IS IMPRACTICAL DUE TO DIRECTION OF FLANGE OR DANGER OF DAMAGE TO MASKING EMULSION (SCRATCHING, IMPROPER FIT DUE TO EMULSION BUILD-UP, ETC.) "ETTP's" SHALL BE CUT TO THE TANGENT OF THE RADIUS OF THE FLANGES LESS .030 FOR MASK AND BUILD-UP.
- (c) MINIMUM OF "ETTP's" TO BE USED. "ETTP" TO INCORPORATE AS MANY DIFFERENT DEPTHS ON ONE TEMPLATE AS PRACTICAL.
- (d) IF MORE THAN ONE "ETTP" IS MADE FOR A PART EACH SEGMENT IS TO BE STAMPED "P".  
MAIN TOOL TO SHOW HOW MANY TOOLS SUCH AS:  
P4            4 TOOLS  
P3            3 TOOLS, ETC.
- (e) UNDERCUT (EAT BACK) SHALL BE FIGURED PER THE FOLLOWING PAGES. ON CLOSE TOLERANCE PARTS IT IS NECESSARY TO RUN A TEST SAMPLE AS VARYING CONDITIONS MAKE IT IMPOSSIBLE AT PRESENT TO ESTABLISH A SET METHOD OF CALCULATING THE AMOUNT OF EAT BACK.
- (f) STANDARD TEMPLATE STOCK TO BE USED FOR ALL TEMPLATES.

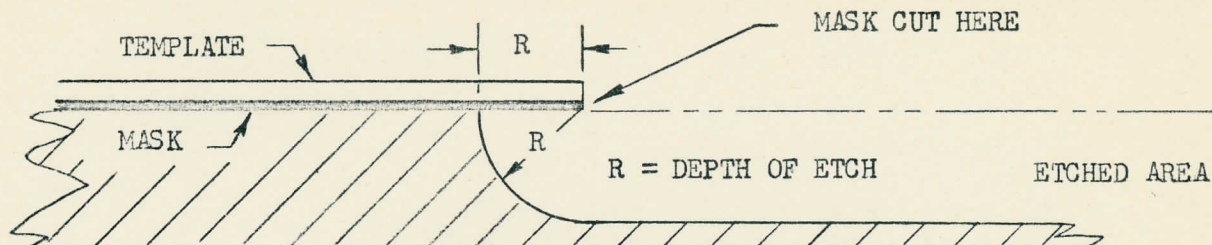
### 6. TOOL ORDERS

- (a) TO SHOW AGE AND HEAT TREAT.
- (b) SPECIFY EXACT NUMBER OF DEPTHS TO BE ACCOMPLISHED BY "ETTP".
- (c) TOOL CARD NOT TO INDICATE NUMBER OF "ETTP's" NEEDED TO ACCOMPLISH ETCH.
- (d) TOOL ORDERS TO SHOW TOOL SERIAL NO. OF COORDINATION TOOL, SUCH AS, "DRSH", ETC.
- (e) TOOL ORDERS TO SHOW IF ETCH IS PERFORMED BEFORE OR AFTER FORMING.
- (f) LOCATING HOLES FOR "ETTP's" TO BE LEFT TO DISCRETION OF SHOP.

DRAWN	CAME 11-1-56	ETCH TEMPLATE DATA	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
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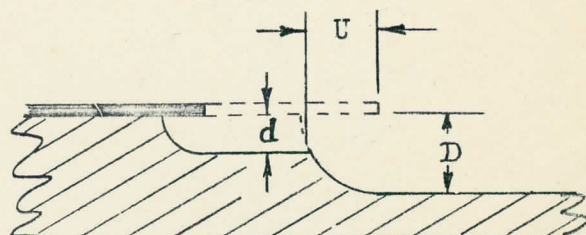
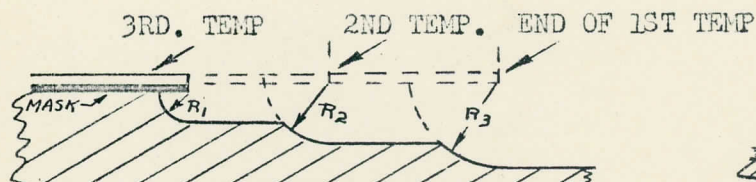


THE ETCHANT SOLUTION REMOVES METAL AT APPROXIMATELY AN EQUAL RATE IN ALL DIRECTIONS. THIS REQUIRES THAT THE MASK BE CUT AT A POINT INSIDE THE ETCHED AREA AN AMOUNT EQUAL TO THE TOTAL DEPTH OF ETCH. THE TEMPLATE MUST INCORPORATE THIS ALLOWANCE FOR EAT-BACK.



THE RADIUS EVOLVED AND TEMPLATE ALLOWANCE MUST BE BASED ON TOTAL DEPTH AND NOT ON DIFFERENCE IN DEPTHS OF ETCHED AREAS.

TO CALCULATE THE TEMPLATE ALLOWANCE TO BE MADE FOR STEPPED ETCHES SUCH AS FOR THE EDGE OF THE FIRST TEMPLATE THE FORMULA SHOWN BELOW CAN BE USED.



$$U = \sqrt{D^2 - d^2}$$

U = EAT BACK ALLOWANCE

D = DEPTH OF ETCH AT BOTTOM OF STEP

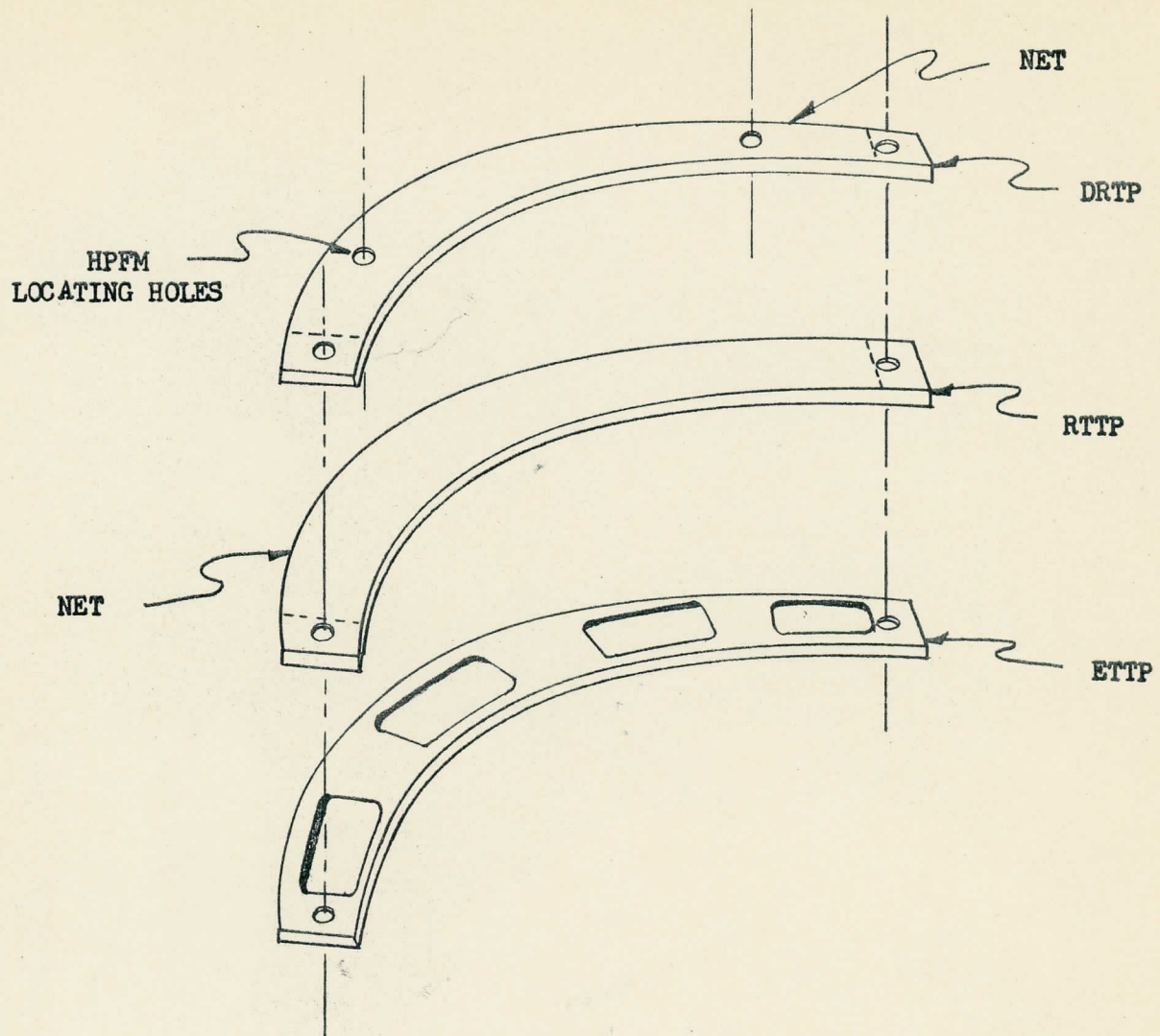
d = DEPTH OF ETCH AT TOP OF STEP

#### EXAMPLE - 3 STEP TEMPLATE

	1ST TEMP.	2ND TEMP.	3RD TEMP.
R <sub>1</sub> = .030	U = $\sqrt{R_3^2 - R_2^2}$	U = $\sqrt{R_2^2 - R_1^2}$	U = D = R <sub>1</sub>
R <sub>2</sub> = .060	U = $\sqrt{.0081 - .0036} = \sqrt{.0045}$	U = $\sqrt{.0036 - .0009} = \sqrt{.0027}$	D = .030
R <sub>3</sub> = .090	U = .067	U = .051	

DRAWN	CNE 10-24-56	ETCH TEMPLATE DATA	TOOL FABRICATION PROCEDURE MANUAL
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DRAWN	CAME 10-25-56	ETCH TEMPLATE TOOL ILLUSTRATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 71
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1/2" EXCESS FOR ETCH PLUS  
ANY EXCESS REQUIRED  
FOR FORM

MKTP

TOGA

DRSH

1/2" EXCESS FOR ETCH  
(ROUGH TRIM)

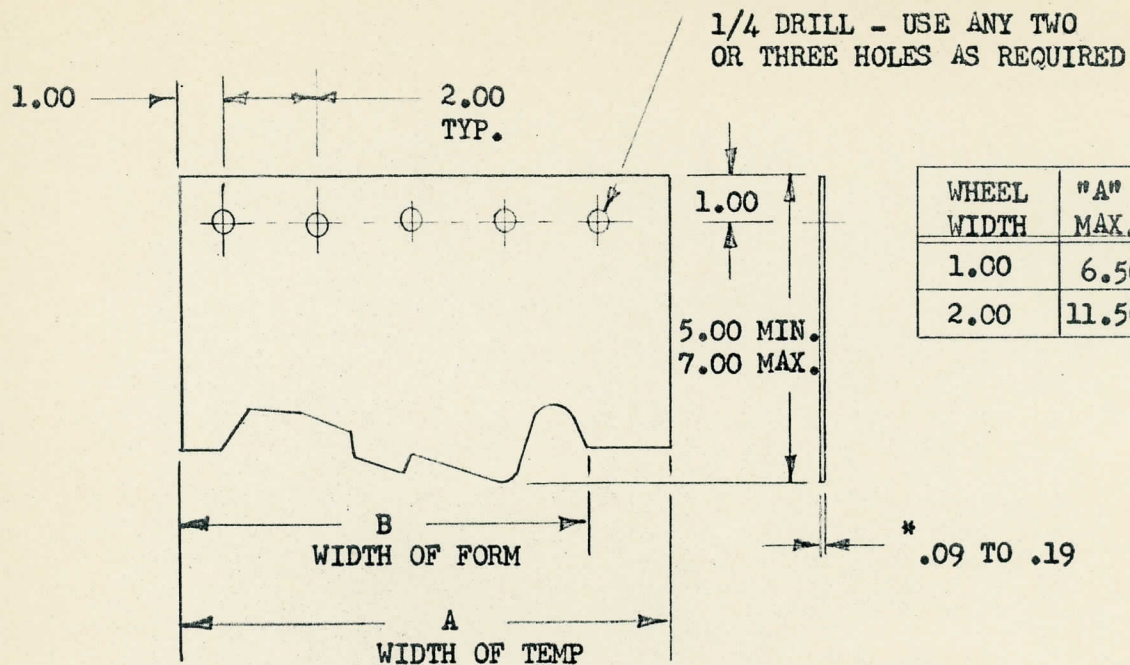
ETTP

DRJI

DRAWN	CAME 10-25-56	ETCH TEMPLATE TOOL ILLUSTRATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 72
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# GRINDING TEMPLATE "GRTP"



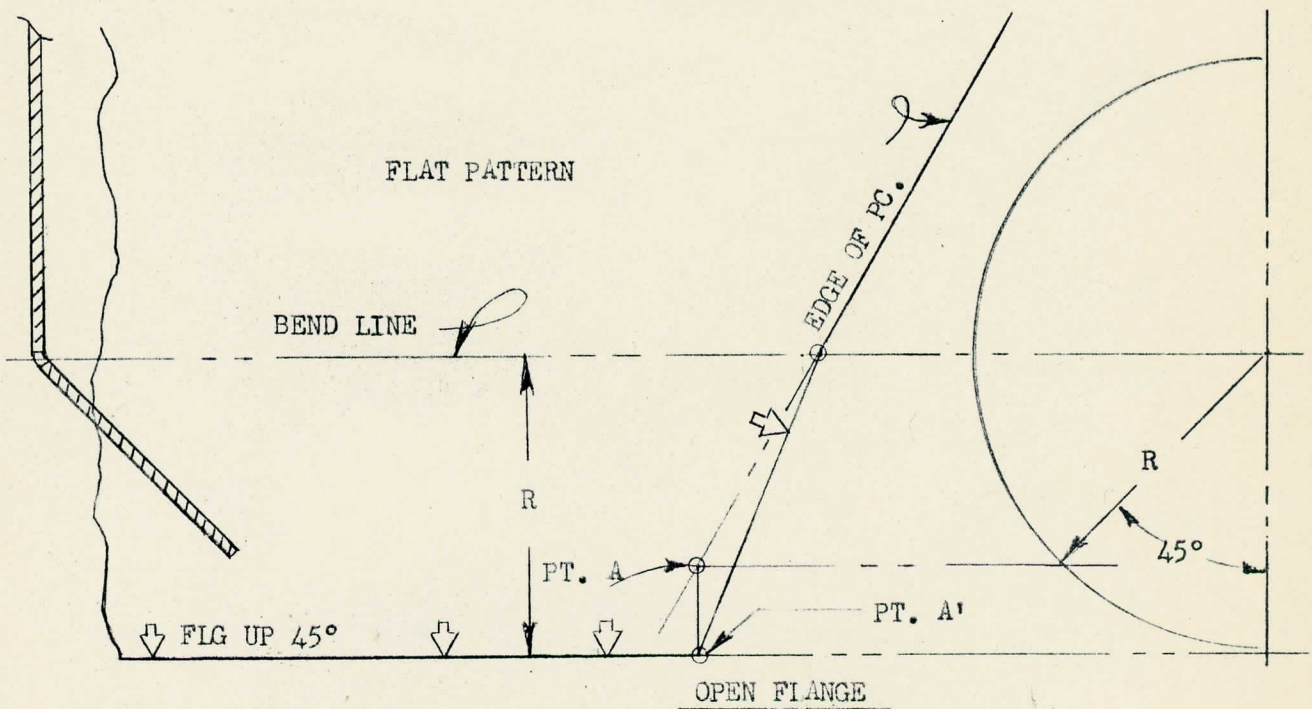
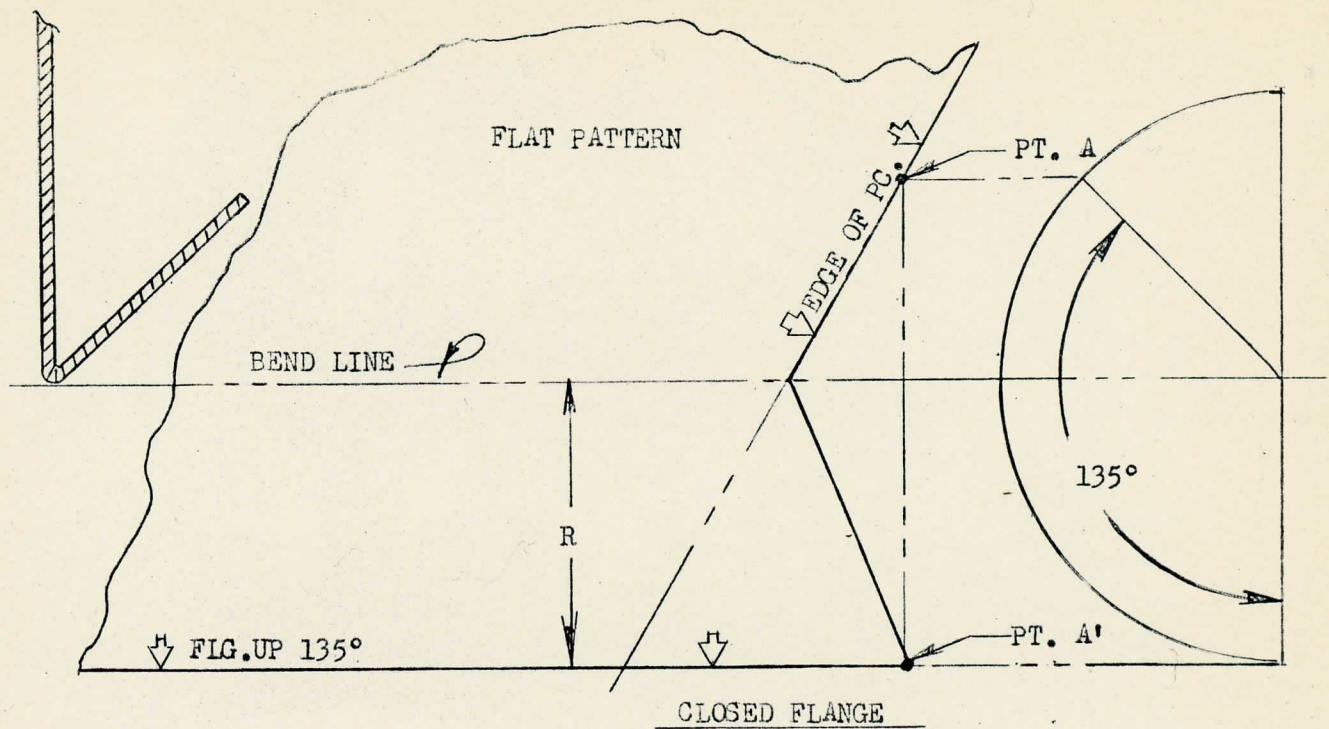
\* THE TEMPLATE MUST BE FLAT AS A WARPED TEMPLATE WILL CAUSE ERRORS IN FORM. TEMPLATE MUST BE .093 PLUS OR MINUS .002 IF A MATING TEMPLATE IS TO BE CAST IN TEMPLATE CASTING FLASK.

THE FORM ON THE TEMPLATE IS THE SAME AS THE FORM ON GRINDING WHEEL WITH A 5 TO 1 RATIO, BUT IS OPPOSITE OF THE FORM TO BE GROUND ON THE WORK.

A MATING TEMPLATE CAN BE CAST TO MATCH TEMPLATE FABRICATED FROM SHEET STOCK BY USING TEMPLATE CASTING FLASK. IF MATING TEMPLATES ARE REQUIRED FABRICATE WHICHEVER ONE IS EASIER TO MAKE FROM SHEET STOCK AND THEN CAST MATING ONE.

DRAWN	CAME 10-25-56	GRINDING TEMPLATES (GRTP) DIAFORM WHEEL FORMING ATTACH.	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMIC CORPORATION SAN DIEGO	PAGE 73
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$R$  DEVELOPED LENGTH OF FLANGE

PT. A' (CORNER OF FLANGE) DETERMINED BY PROJECTION OF PT. A

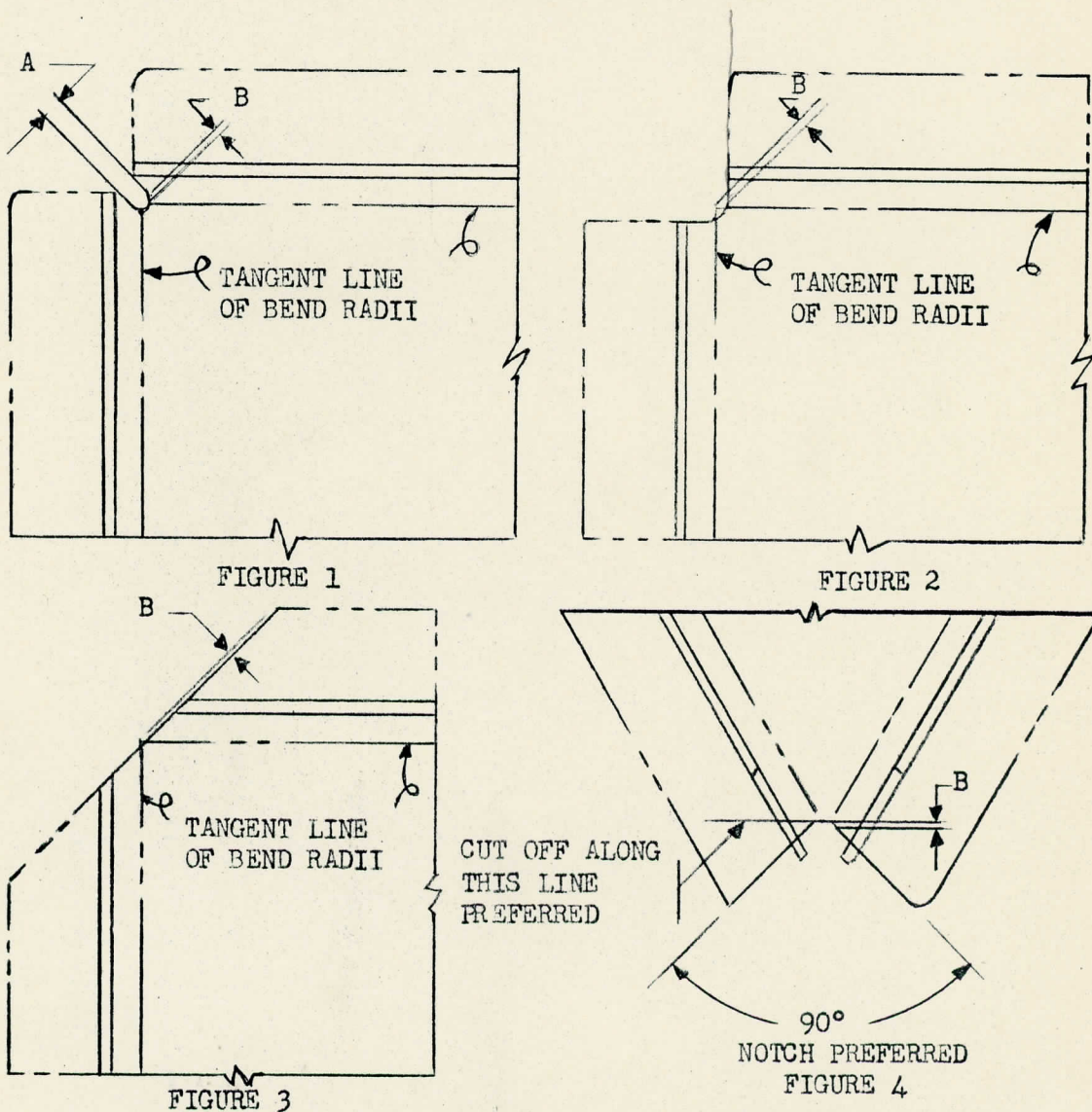
DRAWN	CAME 10-15-56	MARK TEMPLATE - DEV. FLAT PATTERN	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 10-20-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> <small>SAN DIEGO</small>	PAGE 78
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ALL RELIEF RADII SHALL BE .188 FOR GAGES UP TO AND INCLUDING .091 MATERIAL AND .250 FOR GAGES OVER .091 MATERIAL. IF THE DESIGN REQUIRES A SLOT ("A" DIMENSION) THAT IS NOT .375 OR .50, THE RELIEF RADII SHALL EQUAL ONE-HALF THE SLOT WIDTH EXCEPT FOR CONDITION AS SHOWN IN FIGURE #9.

A - .375 OR .50 FOR SLOTS UP TO 3" LONG FOR GAGES OF .064 AND UNDER, .094 MAY BE USED IF APPROVED BY "TOOL DESIGN ENGINEER".

B - .031 FOR GAGES UP TO .102 AND .062 FOR GAGES OF .125 AND OVER.



NOTE: INTERSECTIONS OF BL & RELIEF TO BE DRAWN AS SHOWN, NOT AS FINISHED PART MAY APPEAR.

DRAWN	CAME 11-1-56	MARK TEMPLATE DEV. OF RELIEF RADII	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-10		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 79
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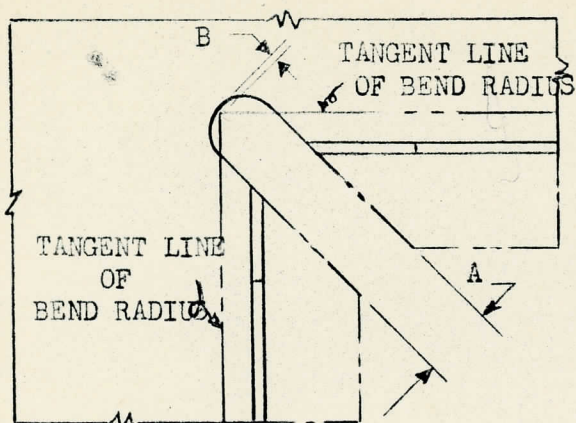


FIGURE 5

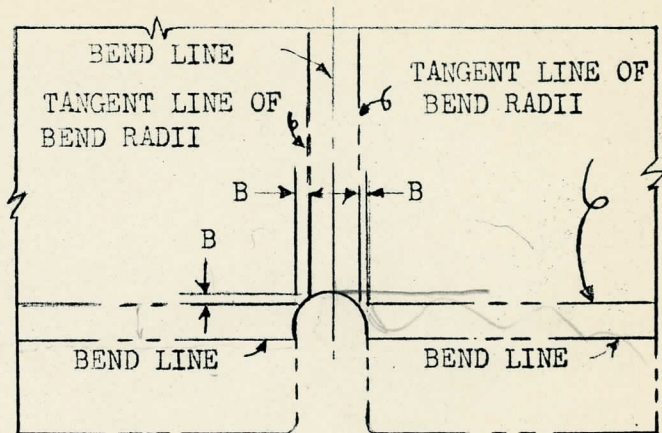


FIGURE 8

TO SUIT (MINIMUM OF .378 IF POSSIBLE)

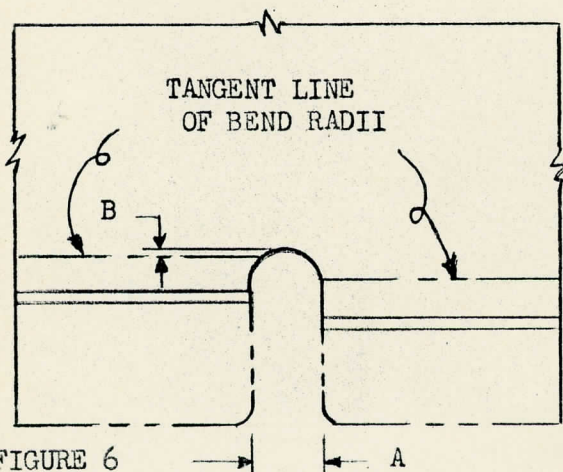


FIGURE 6

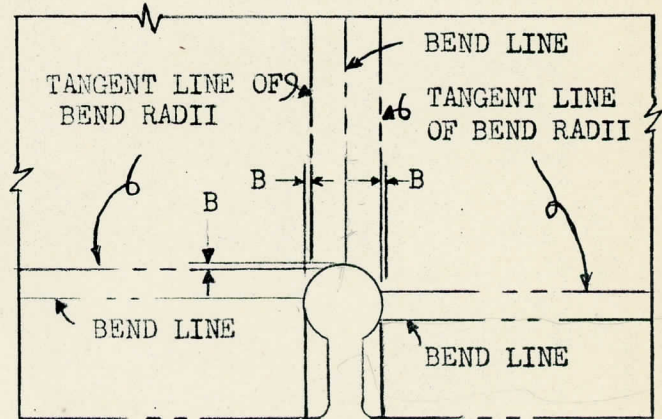
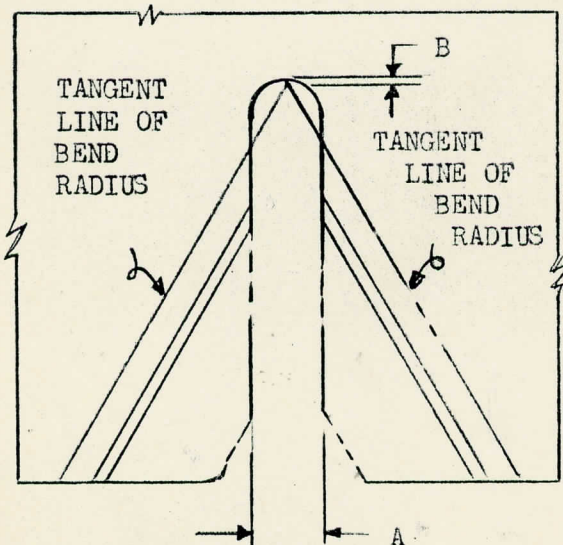


FIGURE 9

TO SUIT

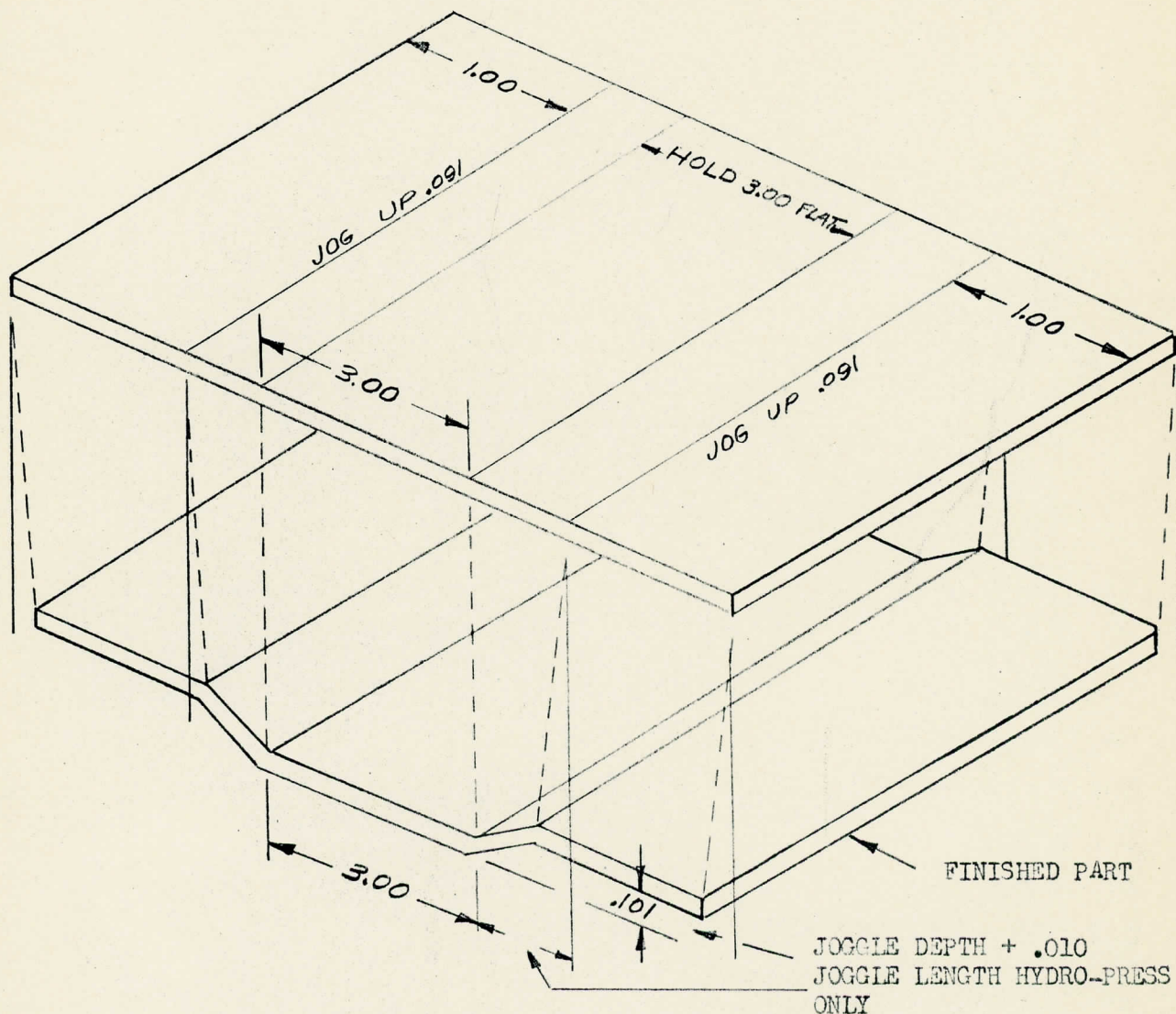


USE ONLY WHEN NECESSARY TO OBTAIN REQUIRED EDGE DISTANCE.

NOTE: INTERSECTING OF B.L. & RELIEF TO BE DRAWN AS SHOWN, NOT AS THE FINISHED PART MAY APPEAR.

DRAWN	CAME 11-1-56	MARK TEMPLATE DEV. OF RELIEF RADII	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	RO-BINS 11-10		
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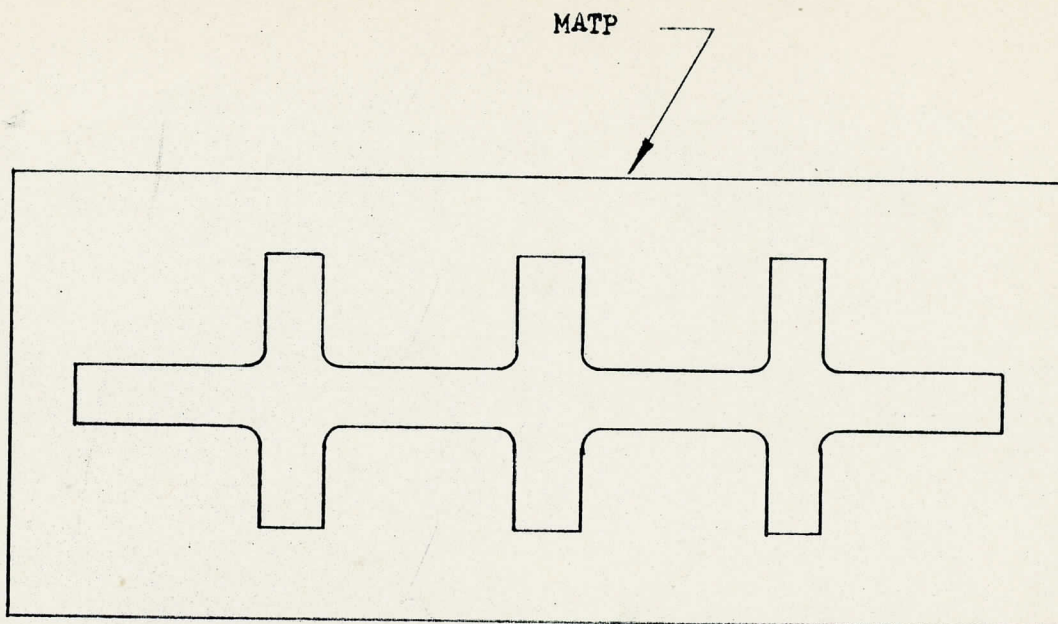


METHOD OF CALLING OUT DOUBLE JOGGLE WHEN GIVEN FLAT SPACE IS REQUIRED.

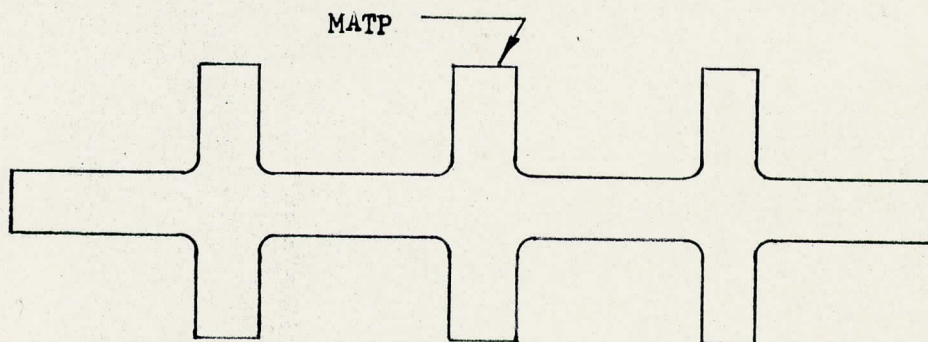
JOGGLE INFORMATION IS NOT TO BE CALLED OUT IN JOGGLED AREA.

JOGGLE LENGTH SHALL BE AT LEAST THREE TIMES ITS DEPTH.

DRAWN	CAME 10-27-56	MARK TEMPLATE JOGGLE CALL OUT	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
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A TOOL USED ON CONTROLLING THE MASKING APPLICATION IN THOSE AREAS OF A PART WHICH REQUIRE PROTECTION FROM SUBSEQUENT SPRAY APPLICATIONS SUCH AS THE ADHESIVE BOND PRIMER USED ON "SCOTCH WELDING".



ANOTHER TYPE OF MATP IS USED FOR CUTTING ADHESIVE BOND MATERIAL TO DESIRED PATTERN OR SHAPE.

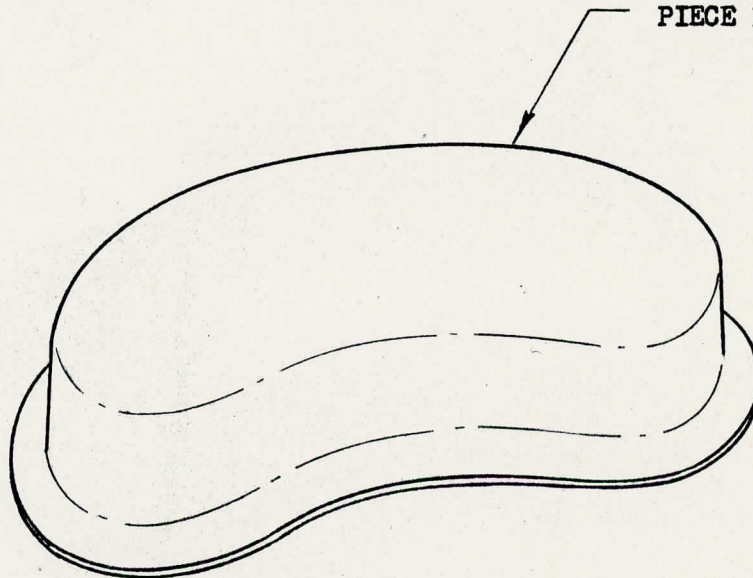
DRAWN	CAME 10-30-56	MASKING TEMPLATE "MATP" TOOL ILLUSTRATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
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RGTP



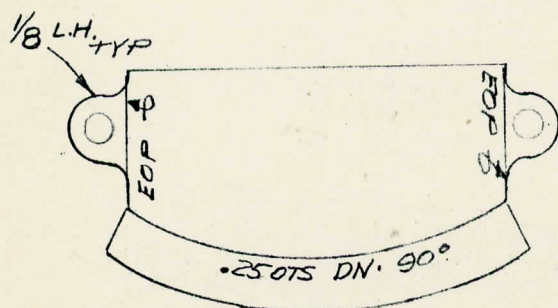
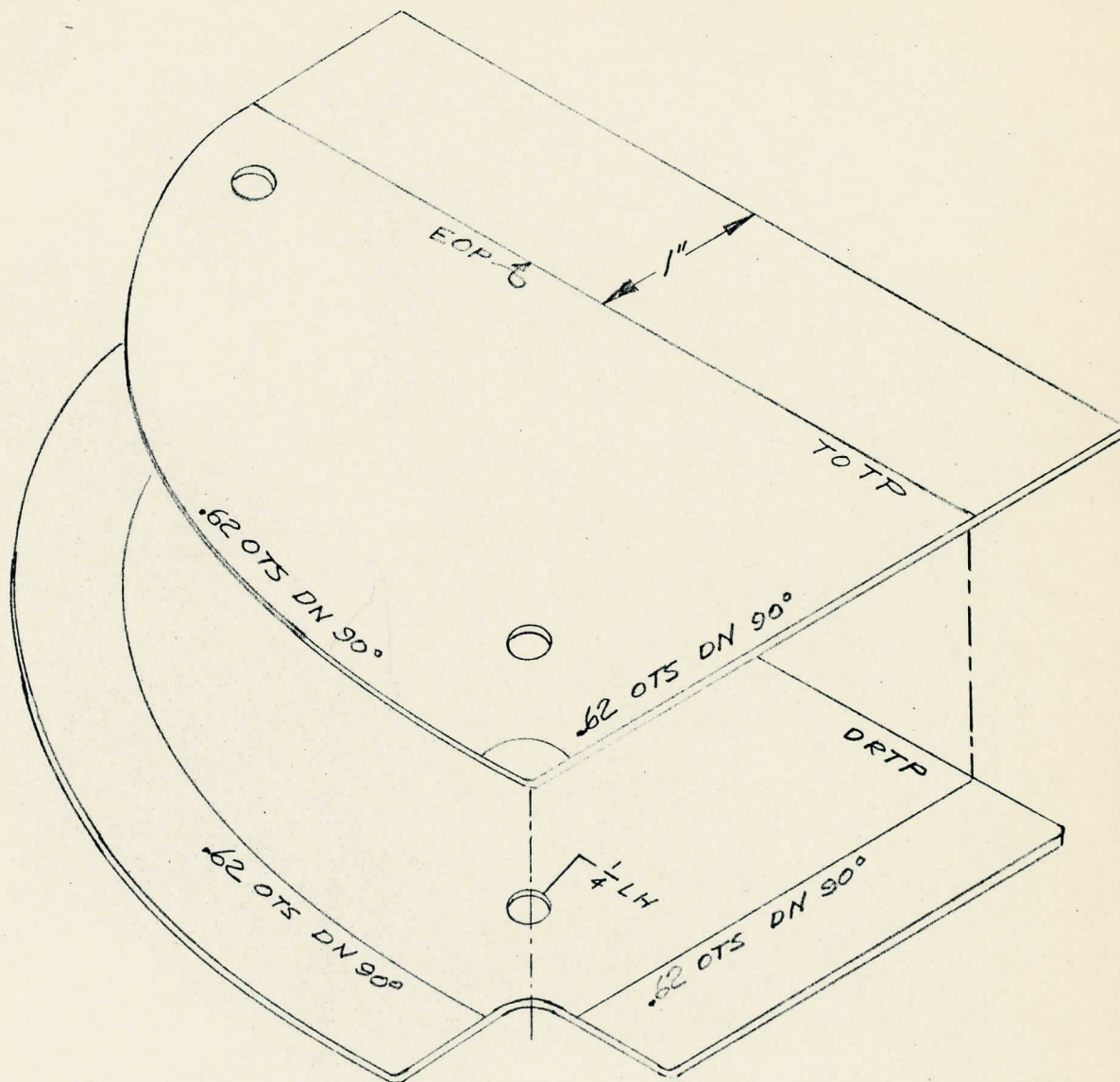
PIECE PART



ROUGH TEMPLATE TO SHOW PERIMETER OF ROUGH SHAPE  
WITH ALLOWANCE FOR FORMING

DEVELOP TO SUIT DIE

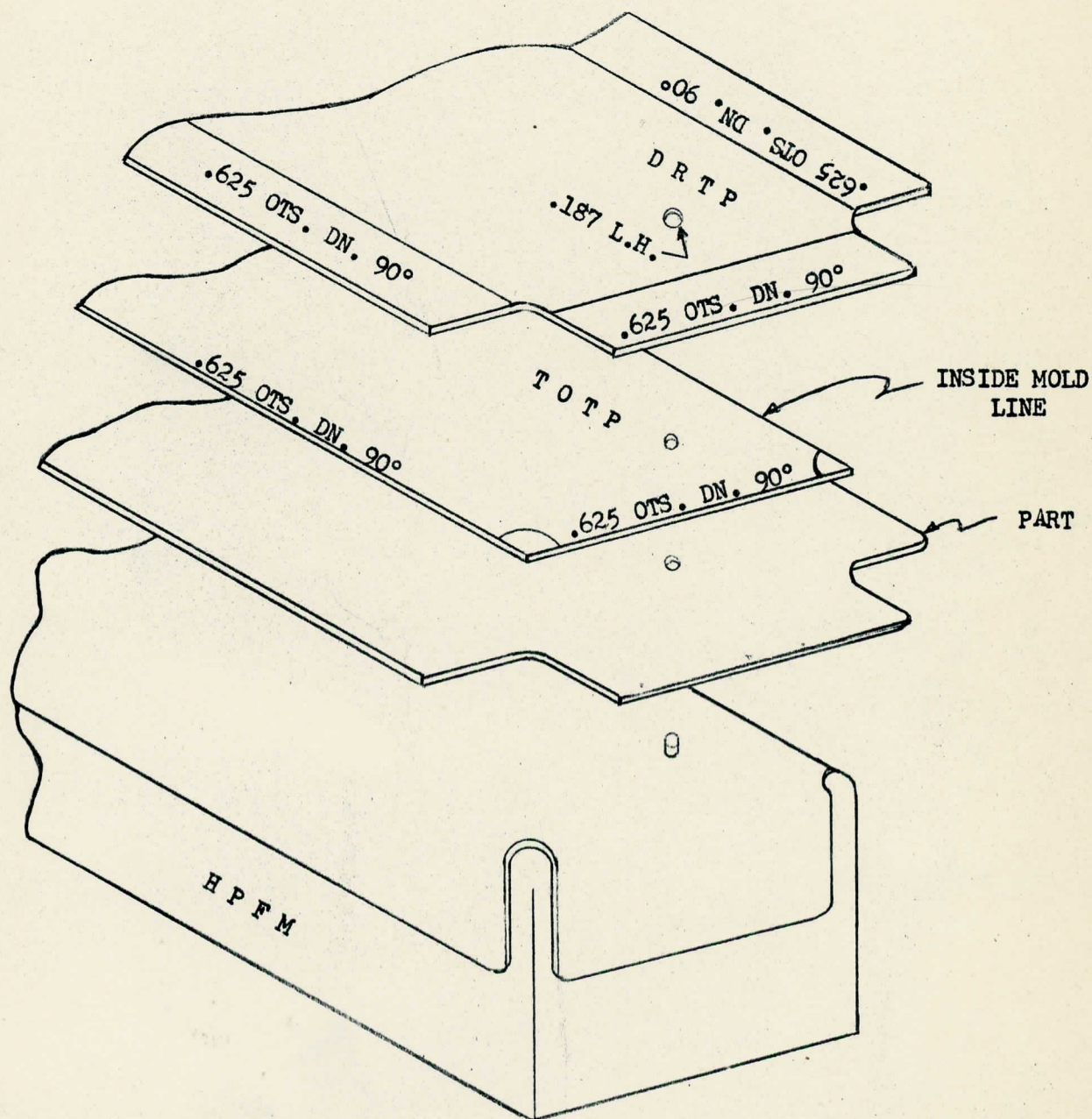
DRAWN	CAME 10-25-56	ROUGH TEMPLATE "RGTP" TOOL ILLUSTRATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>C O N V A I R</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 83
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LOCATING HOLES MAY BE PUT IN TABS OUTSIDE OF PART WHEN THE PART IS TOO SMALL TO INCORPORATE THEM OR IN OTHER SPECIAL CASES WHEN LOCATING HOLES ARE UNDESIRABLE IN THE FINISHED PART. TABS TO BE TRIMMED AFTER FORMING.

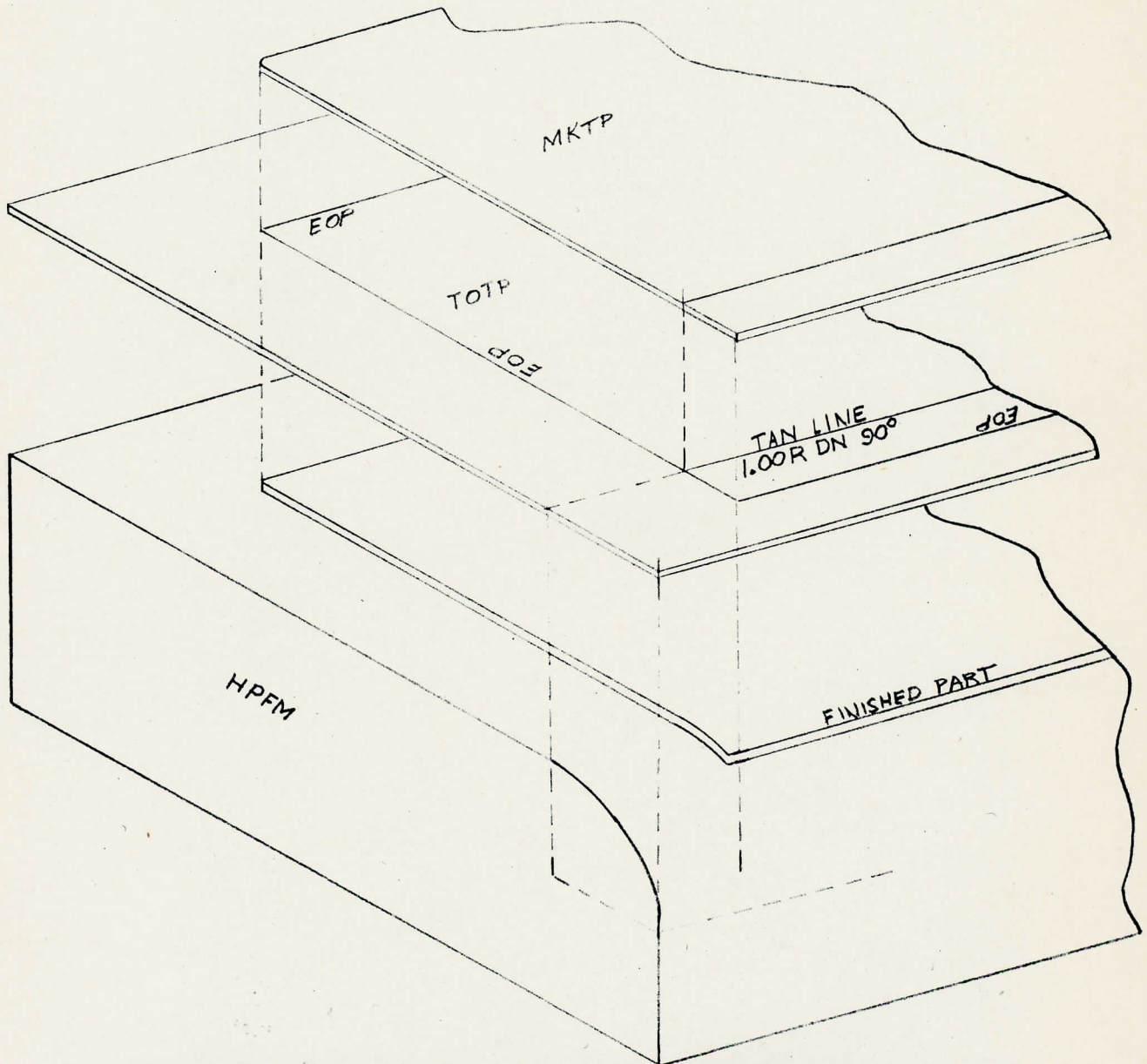
DRAWN	CAME 10-30-56	TOOLING TEMPLATE WITH MATCHING DRTP TEMPLATE	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 88
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DRAWN	CAME 10-30-56	TEMPLATES TO FORM PART HYDRO-PRESS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
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# TOOL LOFT PROCEDURE



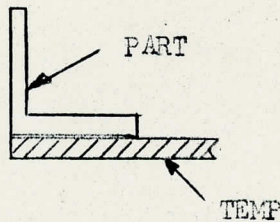
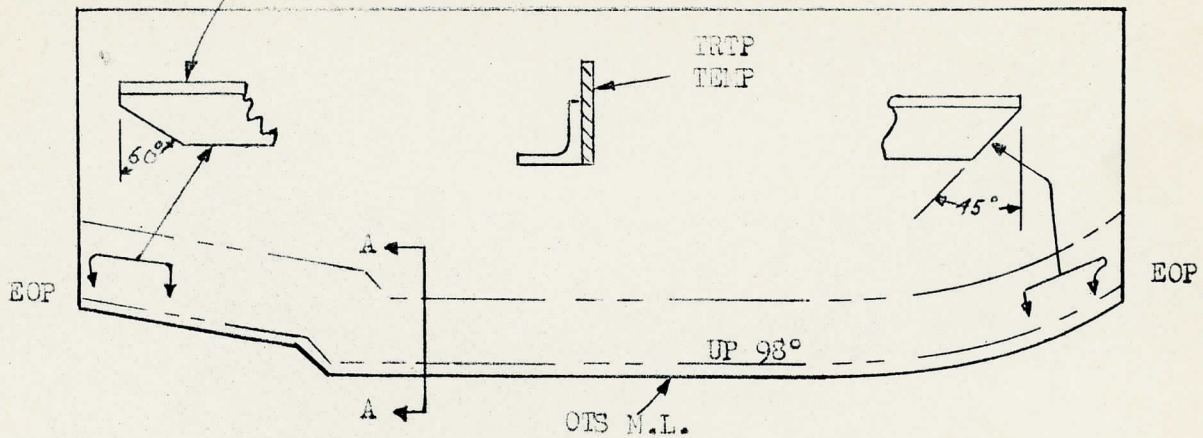
WHEN PART BEING FORMED IS SHORT OF MAKING FULL RADIUS THE TOTP SHOULD COME TO THE TANGENT LINE OF THE RADIUS. THE MKTP SHOULD SHOW THE LINE WHERE THE PART STARTS TO BEND.

DRAWN	CAME 10-30-56	TOOLING TEMPLATE PART SHORT OF FULL RADIUS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
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THESE TRTP'S ARE FOR TRIMMING ENDS ONLY & LOCATION OF JOGGLE

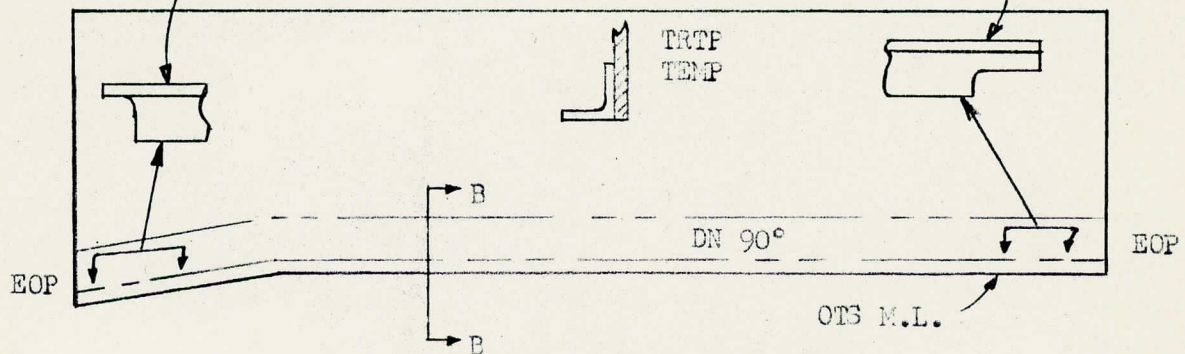
TYP. VIEWS FOR CUTS ON UP OR DOWN STANDING LEG  
WHenever SHOWN ON DWG. OR TOLO



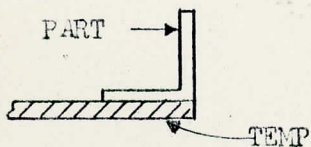
TYP. EXTERNAL TYPE TRTP

SEC A-A  
(ROTATED)

TYP. VIEWS FOR CUTOUTS IN UP OR DOWN  
STANDING LEG, WHENEVER SHOWN ON DWG OR  
TOLO



TYP. INTERNAL TYPE TRTP



SEC. B-B  
(ROTATED)

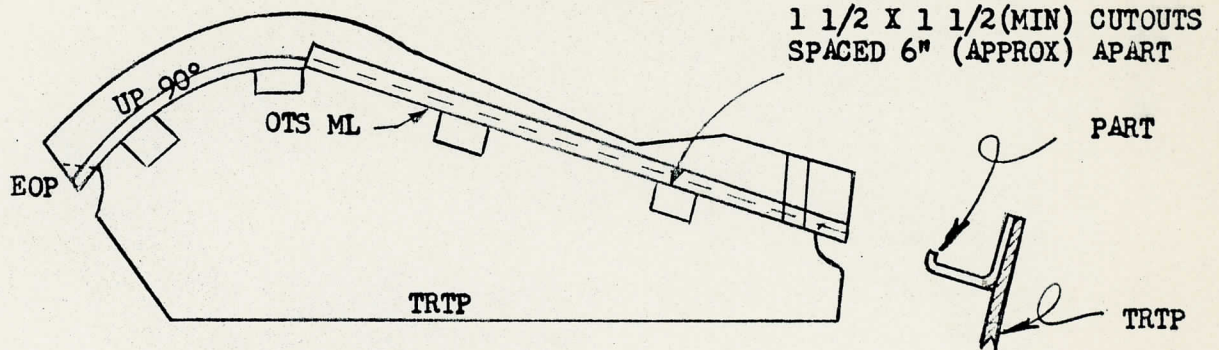
TRTP NOTES:

TRIM TO LENGTH & ENDCUTS, SHOW APPLICATION  
SHOW ALL LINES, JOGGLES & HOLES

DRAWN	CAME 10-24-56	"TRTP" TOOL ILLUSTRATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
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THIS TYPE TRTP FOR FAB RTFM

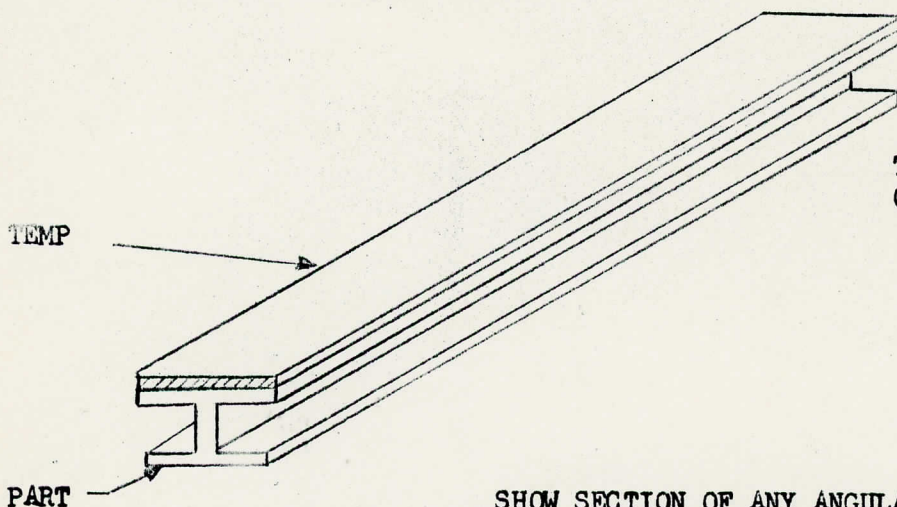
TRIM TO LENGTH & SIZE



TYP. TRTP SHOWING FLANGE  
CUTOFF & JOGGLE

SHOW FLANGE CUTOFF, JOGGLE ON FACE  
OF TEMPLATE AND APPLICATION

TRIM TO LENGTH & SIZE AS INDICATED



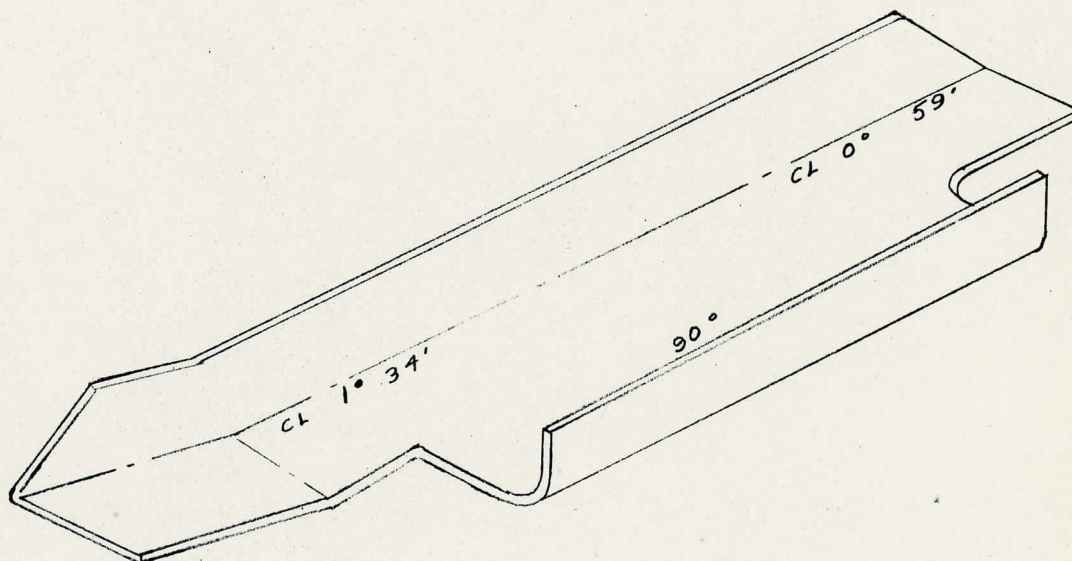
THIS TEMPLATE CAN EITHER BE  
ORDERED AS MKTP OF TRTP

SHOW SECTION OF ANY ANGULAR CUTS  
ON FACE OF TEMPLATE.

DRAWN	CAME 10-25-56	TRIM TEMPLATE TOOL ILLUSTRATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 96
APPROVED			



A FORMED "TRTP" (WHICH WILL BE A REPLICA OF A PRODUCTION PART - A PRODUCTION PART MAY BE USED) IS PREFERRED WHERE A FORMED PART IS INVOLVED.



THE EDGE OR MARKS ON THE SURFACE DETERMINE THE TRIM OF THE PART. JOGGLES AND OTHER INFORMATION ARE SHOWN OR INDICATED. HOLES AS REQUIRED BY PLANNING ARE SHOWN. THE TOOL IS PAINTED RED.

DRAWN	CAME 10-25-56	TRIM TEMPLATE "TRTP" TOOL ILLUSTRATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 97
APPROVED			

STANDARD MINIMUM BEND RADII FOR ALUMINUM AND ALUMINUM ALLOY  
(0° TO 180°) BRAKE AND HYDROPRESS FORMING

STANDARD GAUGE	1100-O	2024-O	2024-T	7075-T
	3003-O	6061-W	7075-W	2024-RT
	5052-O	7075-O	6061-T	2014-T
	6061-O	5052-1/2H	1100-H	
		2014-O	2014-W	
		1100-1/2H		
.012	.03	.03	.03	.06
.016	.03	.03	.03	.06
.020	.03	.03	.03	.08
.025	.03	.03	.06	.09
.032	.03	.06	.09	.12
.040	.06	.06	.09	.19
.051	.06	.06	.12	.25
.064	.08	.09	.16	.31
.072	.09	.09	.19	.38
.081	.09	.12	.22	.44
.091	.12	.16	.25	.50
.102	.12	.16	.31	.56
.125	.16	.19	.38	.69
.156	.16	.25	.44	.88
.188	.19	.31	.69	1.00
.250	.25	.44	1.00	1.50

2024-T80 IS FORMED IN 2024-O CONDITION - USE 2024-O BEND RADIUS  
2024-T81 IS FORMED IN 2024-T CONDITION - USE 2024-T BEND RADIUS  
2024-T86 IS FORMED IN 2024-RT CONDITION - USE 2024-RT BEND RADIUS

DRAWN	CAME 10-23-56	STANDARD MINIMUM BEND RADII FOR ALUMINUM AND ALUMINUM ALLOY	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> <small>SAN DIEGO</small>	PAGE 100
APPROVED			



# MINIMUM STANDARD BEND RADII FOR MAGNESIUM ALLOY

## STANDARD MINIMUM BEND RADII

### MAGNESIUM ALLOYS (0° TO 90°)

STANDARD GAUGE	DOW FS-1a or AM-C52S-0		DOW FS-1h or AM-C52S-H		DOW JS-1a or MA-C54S-0		DOW JS-1h or AM-C54S-H		DOW Ma or AM-3S-0		DOW Mh or AM-3S-H	
	COLD	HOT	COLD	HOT	COLD	HOT	COLD	HOT	COLD	HOT	COLD	HOT
.016	.09	.03	.19	.06	.16	.09	.31	.09	.16	.06	.25	.06
.020	.09	.06	.19	.09	.19	.09	.38	.12	.19	.06	.31	.09
.025	.12	.06	.25	.12	.22	.12	.50	.16	.19	.09	.38	.12
.032	.16	.06	.31	.12	.31	.16	.62	.19	.22	.09	.50	.19
.040	.19	.09	.38	.22	.38	.19	.81	.25	.25	.12	.62	.25
.051	.25	.09	.50	.25	.50	.25	1.00	.31	.31	.16	.75	.31
.064	.31	.12	.62	.38	.56	.31	1.25	.38	.38	.19	.88	.38
.072	.38	.16	.81	.44	.62	.38	1.50	.44	.44	.22	1.25	.50
.081	.44	.19	.81	.44	.75	.44	1.75	.50	.50	.25	1.25	.56
.091	.44	.19	.88	.44	.81	.50	2.00	.56	.56	.31	1.50	.62
.102	.50	.22	1.00	.44	1.00	.50	2.25	.62	.62	.31	1.75	.75
.125	.62	.25	1.25	.50	1.25	.62	2.50	.75	.75	.38	2.00	.88
.156	.75	.31	1.50	.62	1.50	.81	3.00	.88	1.00	.44	2.50	1.00
.188	1.00	.38	2.00	.81	1.75	1.00	4.00	1.00	1.25	.56	3.00	1.25
.250	1.25	.50	2.50	1.00	2.25	1.25	5.00	1.50	1.50	.75	4.00	1.75

DRAWN CAME 10-22-56  
 CHECKED ROBBINS 10-25-56  
 APPROVED  
 APPROVED

#### MINIMUM STANDARD BEND RADII FOR MAGNESIUM ALLOY

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 SAN DIEGO

TOOL FABRICATION  
 PROCEDURES  
 MANUAL

PAGE 101

# STANDARD BEND RADII FOR TITANIUM

STANDARD GAUGE	COMM. PURE (ANNEALED) OR ALLOY (ANNEALED)
.008	.03
.012	.03
.016	.06
.020	.06
.025	.09
.032	.09
.036	.12
.040	.12
.050	.16
.063	.19
.080	.25
.090	.31
.112	.38
.125	.38
.156	.44
.188	.56
.250	.75

DRAWN	CAME 10-22-56
CHECKED	ROBBINS 11-1-56
APPROVED	
APPROVED	

STANDARD BEND RADII FOR TITANIUM

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SAN DIEGO

TOOL FABRICATION  
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STANDARD MINIMUM BEND RADII FOR CARBON STEEL & STEEL ALLOY 0° TO 90°: THIS BEND RADII IS PRODUCTION STANDARD. BEND RADII OTHER THAN THAT SHOWN IN TABLE BELOW SHALL NOT BE SPECIFIED UNLESS AUTHORIZED AND APPROVED BY THE PROPERLY DESIGNATED AUTHORITIES.

STANDARD MINIMUM BEND RADII

CARBON STEEL & STEEL ALLOY  
(0° TO 90°)

STEEL				CORROSION RESISTANT STEEL		
STANDARD GAUGE	1025 OR 4130 ANNEALED	4130 NORM.	ANNEALED	1/4 HARD	1/2 HARD	FULL HARD
.008	.03	.03	.03	.03	.03	.06
.012	.03	.03	.03	.03	.03	.09
.016	.03	.06	.03	.03	.06	.09
.020	.06	.06	.03	.03	.06	.12
.025	.06	.09	.03	.06	.09	.16
.030	.06	.09	.03	.06	.09	.16
.035	.06	.12	.03	.06	.12	.16
.042	.09	.12	.03	.06	.12	.19
.050	.09	.16	.06	.09	.16	.19
.062	.12	.19	.06	.09	.16	.25
.078	.16	.25	.09	.12	.19	.31
.093	.19	.31	.12	.16	.25	.38
.109	.22	.38	.12	.19	.31	.44
.125	.25	.44	.16	.22	.38	.50
.156	.31	.50				
.188	.38	.62				
.250	.50	.75				

DRAWN	CAME 10-21-56	STANDARD MINIMUM BEND RADII FOR CARBON STEEL & STEEL ALLOY 0° TO 90°	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED			
APPROVED			
		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> SAN DIEGO	PAGE 103



# MINIMUM FLANGE HEIGHTS FOR POWER BRAKE UP TO 48" LONG

## MINIMUM FLANGE HEIGHT (POWER BRAKE)

PARTS UP TO 48" LONG

BEND RADII													
MAT'L GAGE	.03	.06	.09	.12	.16	.19	.22	.25	.28	.31	.38	.44	.50
.012	.19	.19	.22	.25	.31	.34	.37	.50	.56				
.016	.19	.19	.22	.25	.31	.34	.37	.50	.56	.64			
.020	.19	.19	.22	.25	.31	.34	.37	.50	.56	.64	.77		
.025	.19	.19	.22	.25	.31	.34	.37	.50	.56	.65	.77	.90	1.02
.032	.22	.22	.22	.25	.31	.37	.37	.50	.56	.65	.78	.90	1.03
.040	.22	.22	.25	.25	.31	.37	.50	.50	.62	.66	.79	.91	1.04
.051		.25	.25	.25	.31	.37	.50	.50	.62	.67	.80	.92	1.05
.064			.31	.31	.37	.37	.50	.50	.62	.68	.81	.93	1.06
.072			.37	.37	.37	.50	.50	.56	.62	.69	.82	.94	1.07
.081				.50	.50	.50	.56	.56	.68	.70	.83	.95	1.08
.091				.50	.50	.56	.56	.56	.68	.71	.84	.96	1.09
.102					.50	.56	.62	.62	.68	.72	.85	.97	1.10
.125						.56	.62	.62	.75	.75	.87	1.00	1.12
.156								.75	.81	.78	.90	1.03	1.15
.188										.87	.93	1.06	1.18
.250											1.12	1.18	1.25

DRAWN	CAME 10-22-56	MINIMUM FLANGE HEIGHTS FOR POWER BRAKE UP TO 48" LONG		TOOL FABRICATION PROCEDURES MANUAL	
CHECKED	ROBBINS 11-1-56				
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> SAN DIEGO		PAGE 104	
APPROVED					



# MINIMUM FLANGE HEIGHTS FOR POWER BRAKE PARTS 48" AND LONGER

## MINIMUM FLANGE HEIGHT (POWER BRAKE)

PARTS 48" AND LONGER

BEND RADII													
MAT'L GAGE	.03	.06	.09	.12	.16	.19	.22	.25	.28	.31	.38	.44	.50
.012	.25	.25	.25	.31	.31	.34	.37	.50	.56				
.016	.25	.25	.25	.31	.31	.34	.37	.50	.56	.64			
.020	.25	.25	.25	.31	.31	.34	.37	.50	.56	.64	.77		
.025	.25	.25	.25	.31	.31	.34	.37	.50	.56	.65	.77	.90	1.02
.032		.25	.25	.31	.37	.37	.37	.50	.56	.65	.78	.90	1.03
.040		.31	.31	.31	.37	.37	.50	.50	.62	.66	.79	.91	1.04
.051		.31	.31	.37	.37	.37	.50	.50	.62	.67	.80	.92	1.05
.064			.37	.37	.50	.37	.50	.50	.62	.68	.81	.93	1.06
.072			.37	.50	.50	.50	.50	.56	.62	.69	.82	.94	1.07
.081				.50	.56	.50	.56	.56	.68	.70	.83	.95	1.08
.091				.50	.56	.56	.56	.56	.68	.71	.84	.96	1.09
.102					.62	.56	.62	.62	.68	.72	.85	.97	1.10
.125					.62	.56	.62	.62	.75	.75	.87	1.00	1.12
.156								.75	.81	.78	.90	1.03	1.15
.188										.87	.93	1.06	1.18
.250											1.12	1.18	1.25

DRAWN	CAME 10-22-56	MINIMUM FLANGE HEIGHTS FOR POWER BRAKE PARTS 48" AND LONGER	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 10-25-56		
APPROVED		C O N V A I R A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 105
APPROVED			



INSERT  
ALIGNING  
STUD  
TOAC 1J8316

INSERT ALIGNING STUD  
LOCATING TEMPLATE  
ASTO 1J-7381

SPACER  
TOAC 1J 8400

DROP HAMMER  
DIE NUT  
TOAC 1J2273

DROP HAMMER  
RAM PLATE.

STUD  
TOAC 1J 7392

STUD THREAD  
GUIDE & PROTECTOR  
TOAC 1J 15518

DROP HAMMER  
DIE.

1J 2273  
REF.

1J8316 REF  
1J7381 REF

1J 8400 REF.  
REMOVE  
FROM DIE  
AFTER  
POUR.

1J2273  
REF.

DROP HAMMER  
DIE

FABRICATION OF  
DROP HAMMER DIE.

1J 7392 REF

1J2273 REF.

USE OF  
DROP HAMMER DIE.

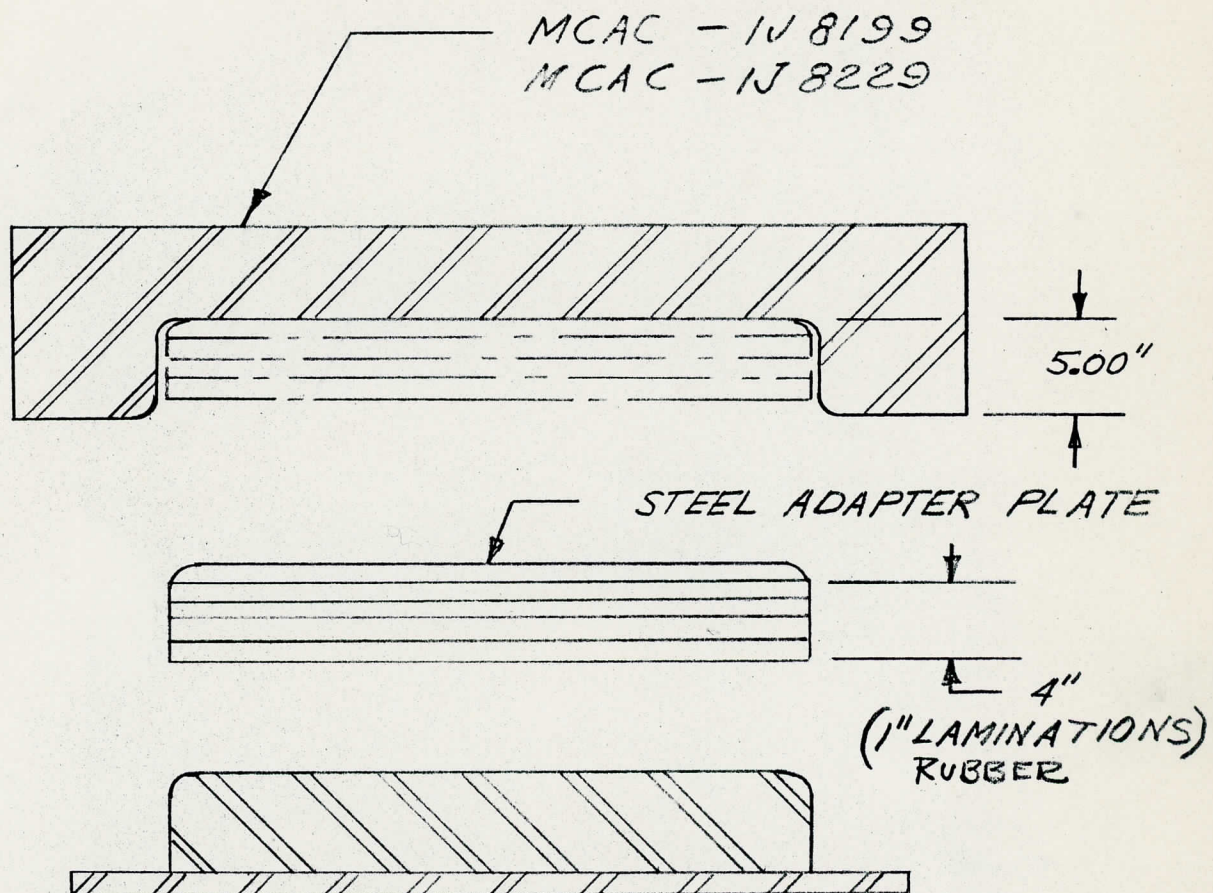
DRAWN	EMERSON 2-14-55
CHECKED	
APPROVED	

ACCESSORY TOOLS-DROP HAMMER  
DIE FABRICATION

CONSOLIDATED VULTEE AIRCRAFT CORPORATION  
SAN DIEGO DIVISION . . SAN DIEGO, CALIFORNIA

TOOL FABRICATION  
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SEE TUBE FILE FOR WORKING DRAWING

DRAWN	CAME 10-25-56	DROP HAMMER DIE TRAPPED RUBBER FORMING	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> SAN DIEGO	PAGE 107
APPROVED			

MAINTENANCE PROCEDURE - TRAPPED RUBBER FORMING DIES

SMALL DIE -

DIE NO. : MCAC - 1J8199 (18 INCH DIA.)  
RUBBER : CVAC # RU1015-15 (1" THICK, 80 SHORE, CUT TO SIZE)

MEDIUM DIE -

DIE NO. : MCAC - 1J8554 (16 X 34 OBLONG)  
RUBBER : CVAC #

LARGE DIE -

DIE NO. : MCAC 1J8229 (24 X 36 OBLONG)  
RUBBER : CVAC # RU1015-20 (1" THICK, 80 SHORE, CUT TO SIZE)

ALL DIES -

CLEANER : CVAC # SOL 1-2 (M.E.K.)  
CEMENT : CVAC # CEM 1000-6 (FLINT-KOTE #974)

NO SUBSTITUTE MAY BE USED FOR ANY OF THE ABOVE MATERIALS, WITHOUT TOOL DESIGN APPROVAL.

A. TO BUILD UP A COMPLETE RUBBER DIE PAD ASSEMBLY, THE FOLLOWING PROCEDURE MUST BE ADHERED TO.

1. THE DIE PAD ADAPTER PLATE IS TO BE FREE OF ALL TRACES OF OLD RUBBER, CLEAN BY SAND BLASTING. CHECK PLATE FOR FLATNESS, PLATE MUST BE FLAT WITHIN .030.
2. CLEAN PLATE BY WASHING WITH CVAC #SOL 1-2. DO NOT TOUCH CLEANED SURFACE WITH FINGERS OR ANY THING WHICH MIGHT LEAVE AN OILY RESIDUE ON SURFACE.
3. DISC GRIND ONE FACE OF ONE PIECE OF CVAC #RU1015-TO SUIT USING 80 TO 100 GRIT ABRASIVE. BRUSH FREE OF GRINDING DUST AND THOROUGHLY CLEAN WITH SOL 1-2. DO NOT TOUCH AFTER CLEANING.
4. AFTER SURFACES OF ADAPTER PLATE AND RUBBER LAMINATE ARE DRY, APPLY ONE BRUSH COAT OF CEM 1000-6 TO CLEANED SURFACES MAKING SURE TO FULLY COVER SURFACES. BRUSH COAT THICKNESS WILL AVERAGE 0.010 - 0.016 INCHES.
5. AFTER 20 MINUTES APPLY SECOND COAT TO BOTH SURFACES.

DRAWN	CAME 10-26-56	DROP HAMMER DIE TRAPPED RUBBER FORMING	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
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APPROVED			



6. AIR DRY UNTIL COATED SURFACES ARE DEFINITELY TACKY, APPROXIMATELY ONE HOUR.
7. PRESS SURFACES FIRMLY TOGETHER TO INSURE CONTACT AT ALL POINTS, BUT DO NOT FORCE CEMENT OUT OF JOINTS, MAINTAIN UNIFORM PRESSURE FOR AT LEAST TWO (2) HOURS TO PROMOTE BETTER ADHESION.
8. AFTER REMOVING PRESSURE, AVOID ROUGH HANDLING FOR AT LEAST 24 HOURS.
9. AFTER 24 HOURS WAITING PERIOD, PREPARE BOTH SIDES OF ADDITIONAL RUBBER LAMINATES, FOLLOWING THE SAME PROCEDURES OUTLINED IN STEPS 3, 4, 5, 6, 7 & 8.

B. TO REPLACE ONLY THE OUTSIDE LAMINATE, USE THE FOLLOWING PROCEDURE:

1. REMOVE COMPLETE POD ADDEMBLY FROM DIE.
2. PLANE OFF THE AMOUNT OF RUBBER REQUIRED TO REMOVE DAMAGE, WORK IN INCREMENTS OF ONE INCH.
3. GRIND SURFACE, USING 80-100 GRIT ABRASIVE. BRUSH FREE OF GRINDING DUST AND THOROUGHLY CLEAN AS OUTLINED IN PRECEDING STEPS.
4. PREPARE REPLACEMENT LAMINATE AND PROCEED AS OUTLINED IN A3 THRU A8.

DRAWN	CAME 10-24-56	DROP HAMMER DIE TRAPPED RUBBER FORMING	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 109
APPROVED			

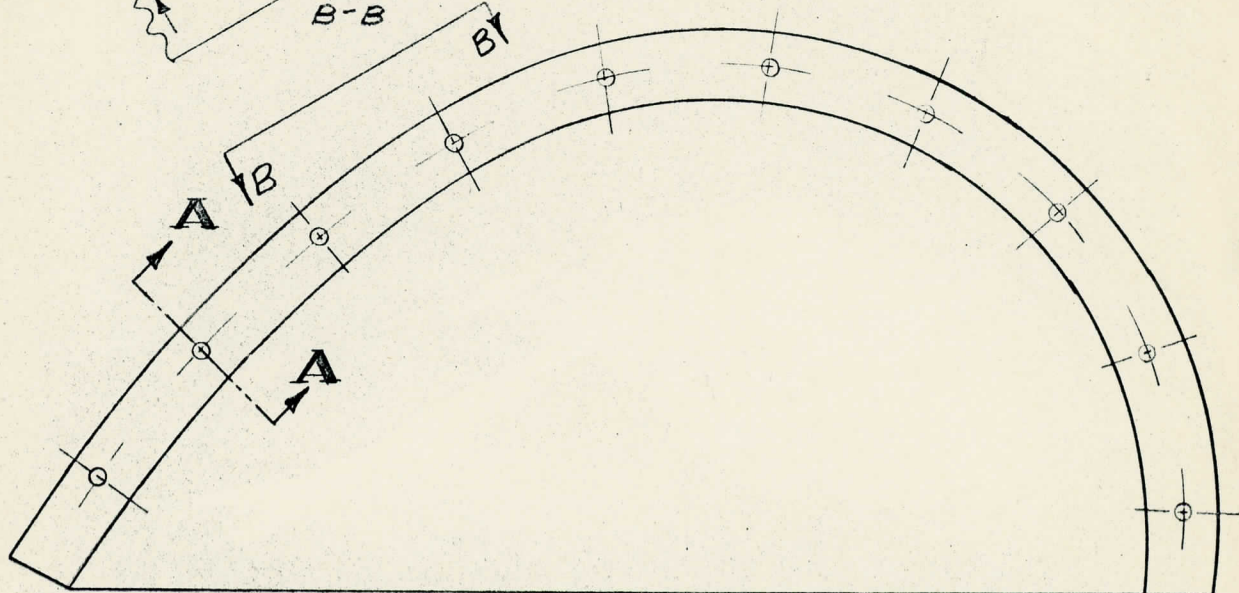
.010 OVER NOM.  
DEPTH OF JOGCEL

ALTERATION

DATE

NAME

VIEW  
B-B



NOTE: USE BOLTS AND PINS  
FOR TIE DOWN OF BLOCK TO  
BASE. DOWEL PIN HOLES  
ARE NOT TO BE DRILLED  
THROUGH FORM BLOCK.

LOCATING PINS  $\frac{3}{16}$  SLIP FIT (CVAC WILL  
FURNISH PINS)

ALLOW FOR SPRING BACK

.25 MIN

SECT. A-A

SMALL & NARROW BLOCKS  
NEED SOLID BASE PLATES

**NOTE:**

1. FOR BEAD FORMS & TOOLS SEE HYDRO-PRESS STANDARD TOOL BOOK.
2. HYDRO-PRESS BEAD FORMS AND CUTTING RINGS WILL BE INSTALLED  
ON THE HPFM'S BY CONVAIR.

DRAWN	CAME 10-25-56
CHECKED	ROBBINS 11-1-56
APPROVED	

HYDRO-PRESS FORM BLOCKS (TYP. ILLUSTRATIONS)

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A DIVISION OF GENERAL DYNAMICS CORPORATION

SAN DIEGO

TOOL FABRICATION PROCEDURES MANUAL
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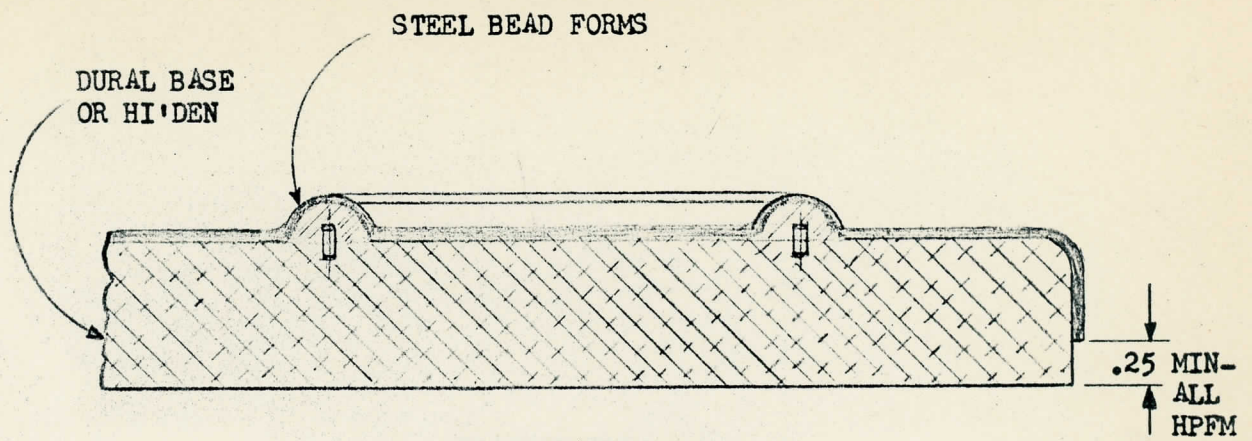


ILLUSTRATION - 1

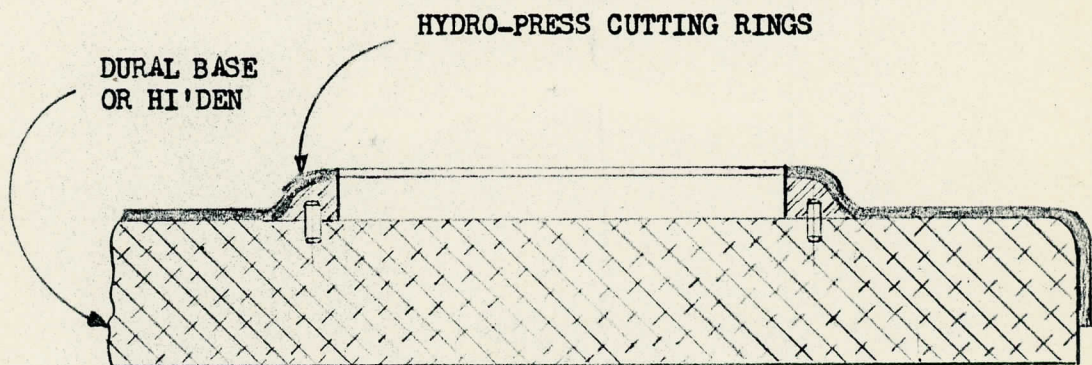


ILLUSTRATION - 2

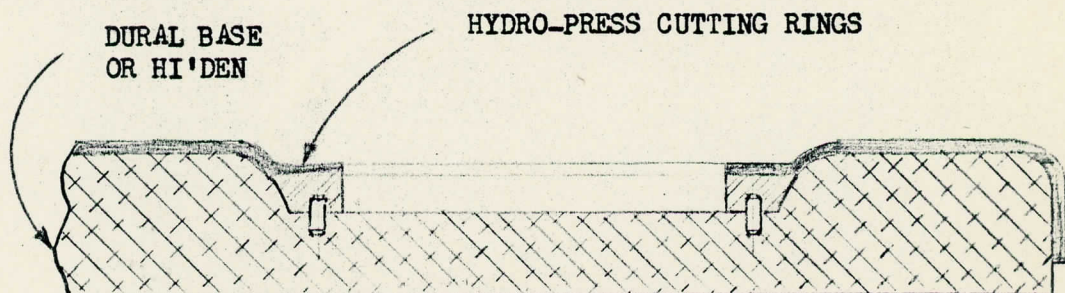
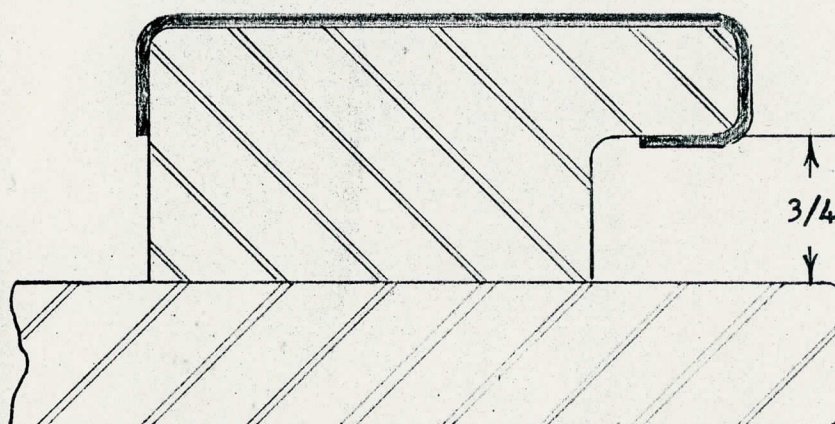
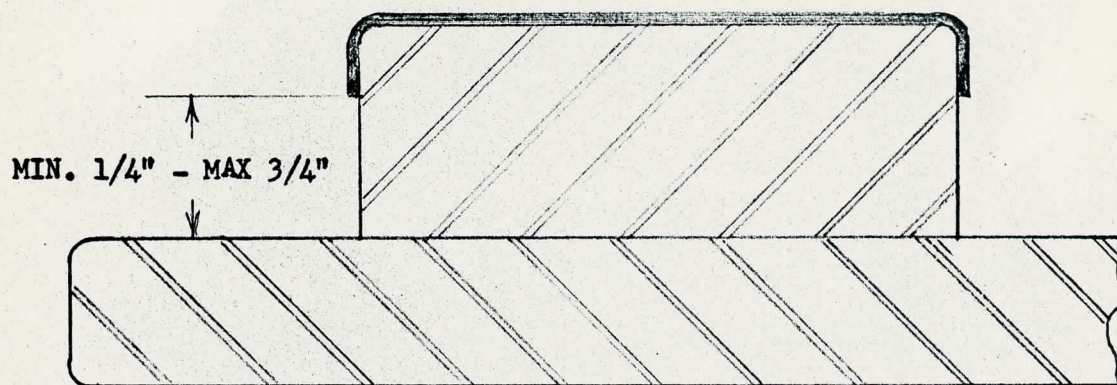


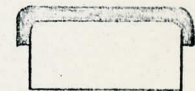
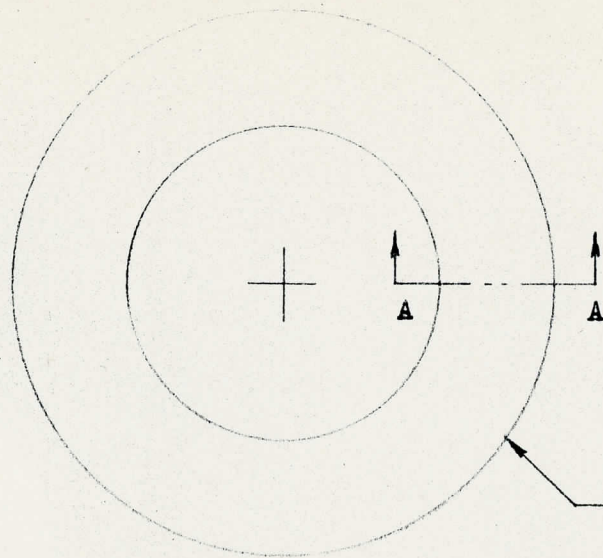
ILLUSTRATION - 3

DRAWN	CAME 10-25-56	HYDRO-PRESS FORM BLOCKS (TYPICAL ILLUSTRATIONS)	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 115
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DRAWN	<i>Samuels</i>	<i>10/10/6</i>	BLOCK - FOR HYDRO-PRESS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS	11-1-56		
APPROVED			<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> <small>SAN DIEGO</small>	PAGE 116
APPROVED				

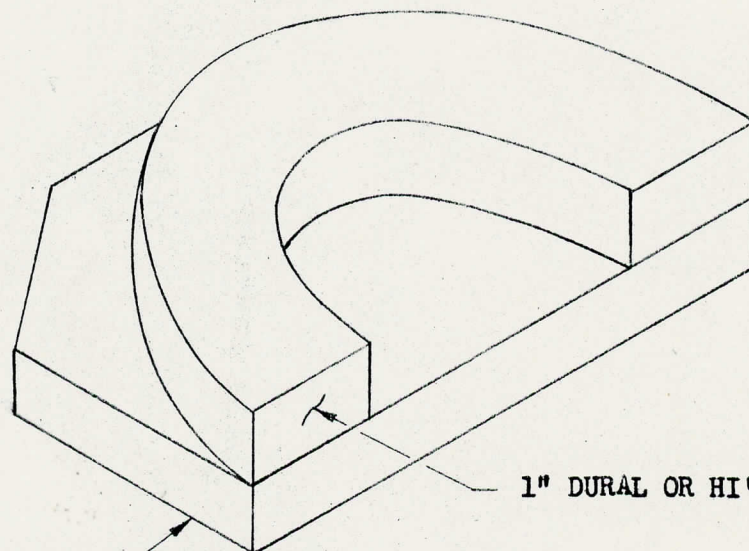




SECT. A-A

DURAL OR HI'DEN  
1" MIN. THICKNESS

NO BASE REQUIRED



1" DURAL OR HI'DEN

BASE DURAL

DRAWN	CAME 10-26-56
CHECKED	ROBBINS 11-1-56
APPROVED	
APPROVED	

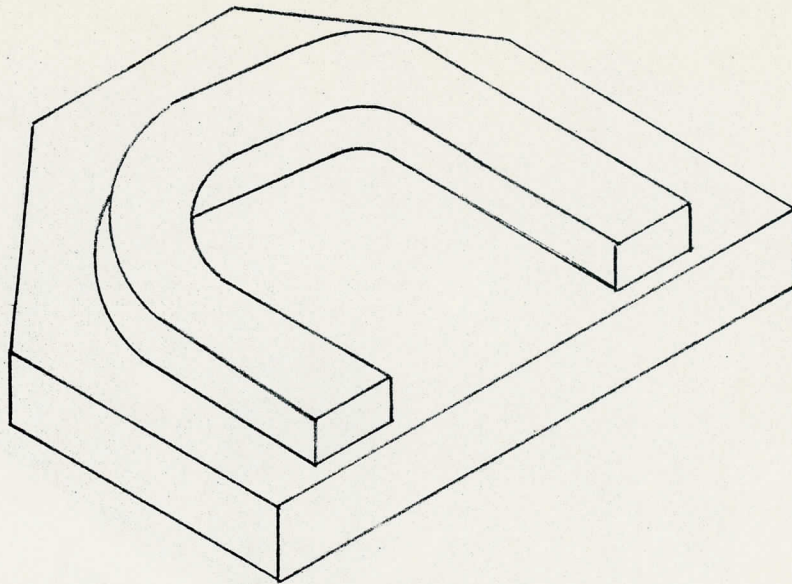
BLOCK - FOR HYDRO-PRESS

**CONVAIR**

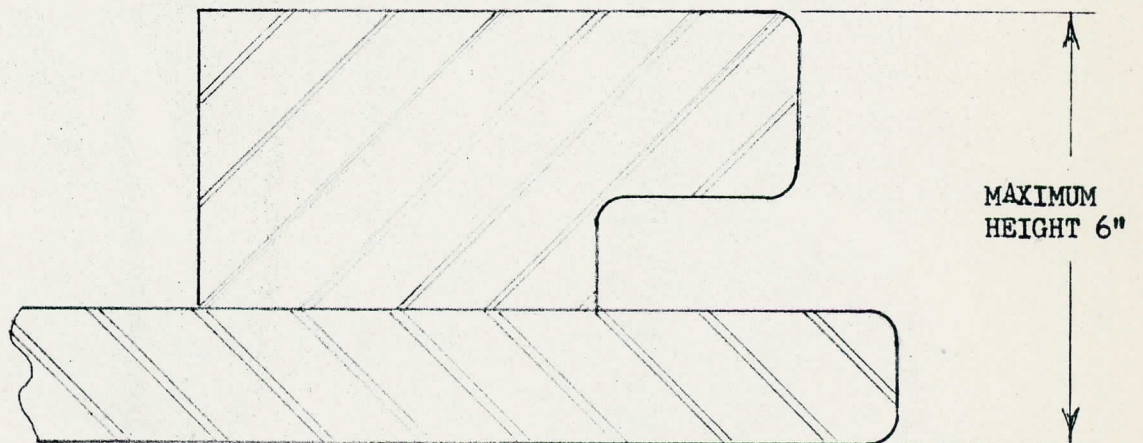
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SAN DIEGO

TOOL FABRICATION  
PROCEDURES  
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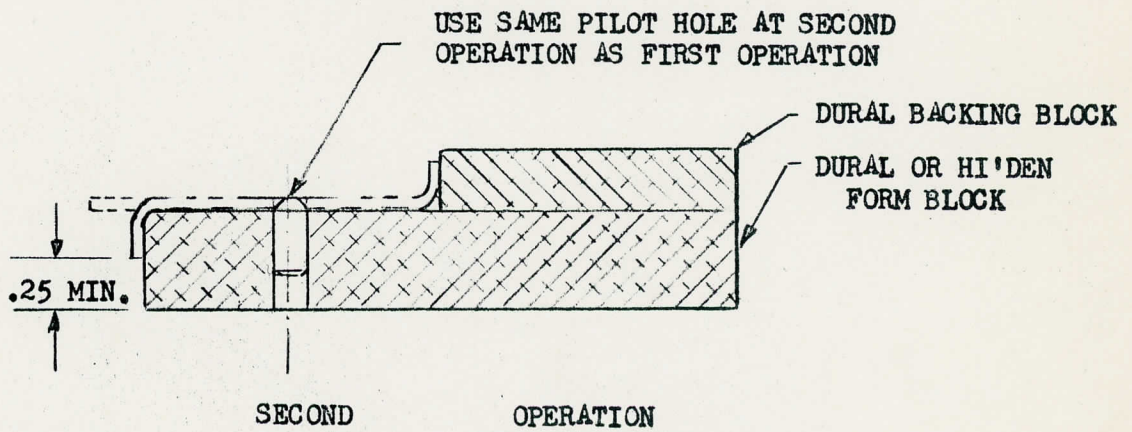
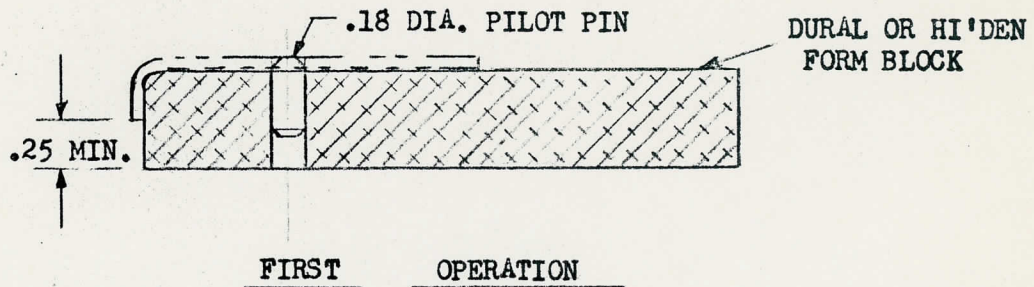
BASE REQUIRED DURAL



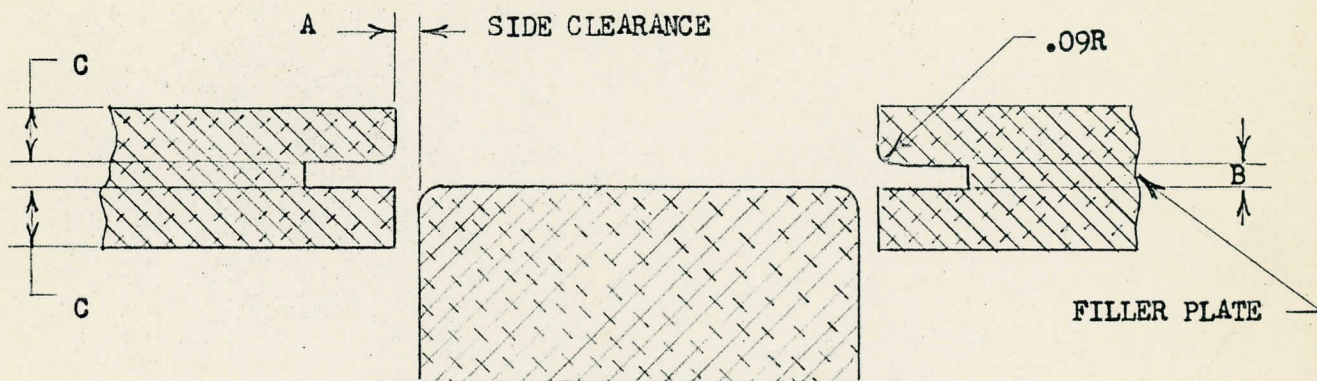
4" MAXIMUM HEIGHT FOR  
SMALL PRESSES

DRAWN	CAME 10-26-56	BLOCK - FOR HYDRO-PRESS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 118
APPROVED			





DRAWN	CAME 10-25-56	SECTION FORMED - TWO OPERATION BLOCK	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 119
APPROVED			



HPFM (REF.)

$A = \text{PART THICKNESS} + .003$

$B = \text{PART THICKNESS} + .008 \text{ TO } + .010$

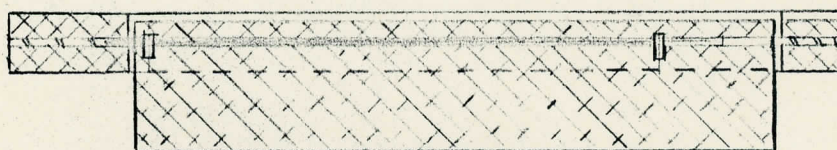
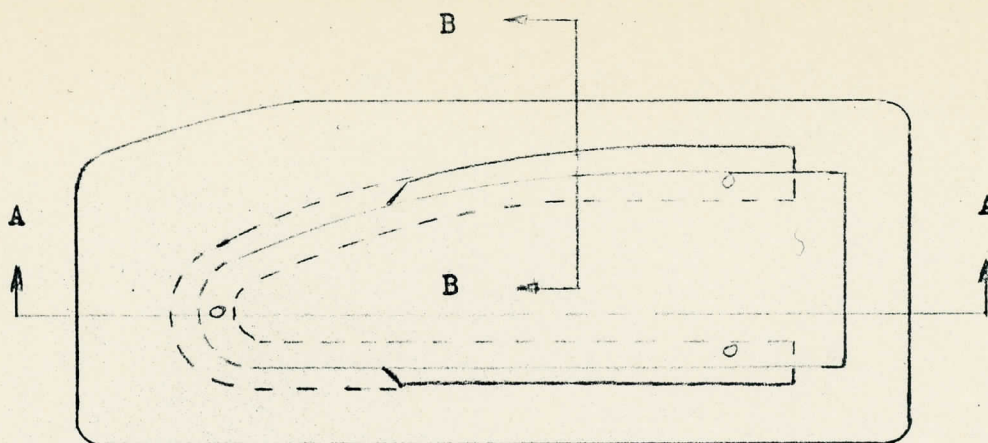
$C = .25 \text{ FOR MATERIAL UP TO } .040$   
 $.31 \text{ FOR MATERIAL } .040 \text{ TO } .052$   
 $.37 \text{ FOR MATERIAL } .052 \text{ TO } .064$

NOTES:

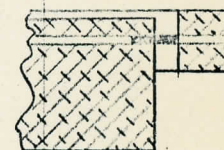
1. USE AND DESIGN OF SHRINK CLIP TO BE LEFT TO DISCRETION OF DEPT. 406-2.
2. IF SHRINK CLIP IS USED, THE HPFM SHOULD BE STAMPED "P-2" AND THE CLIP "P".

DRAWN	CAME 10-26-56	AUXILIARY SHRINK CLIP FOR USE WITH HYDRO-PRESS FORM BLOCK	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> <small>SAN DIEGO</small>	PAGE 120
APPROVED			

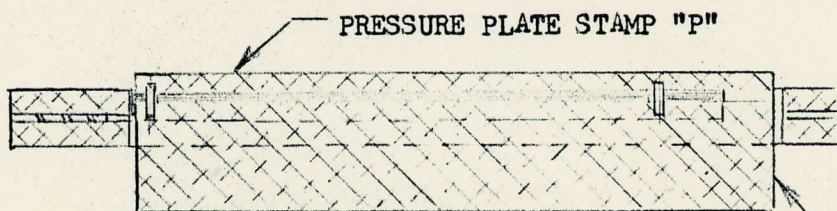




SECTION A-A HPFM (LOADED)

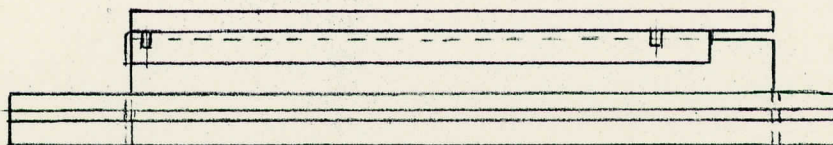


SECTION B-B (LOADED)



SECTION A-A HPFM (FORMING)

HPFM STAMP "P 3"



HPFM OPERATION COMPLETE

SHRINK CLIP TO BE USED ONLY ON PARTS WITH SHARP RADIUS AS SHOWN ABOVE. DEPT 406-2 TO DETERMINE WHEN USED.

DRAWN	CAME 10-25-56	ILLUSTRATION SHOWING USE OF "HPFM" SHRINK CLIP	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 121
APPROVED			

NOTE:

FOR ALL FORMING ON 2024-O AL. AL. USE 2° SPRING BACK  
ALSO USED FOR 7075-O AL. AL.

MAT'L GAGE	2024-T4 (ALUMINUM ALLOY)						
	R A D I U S						
	1/16	3/32	1/8	5/32	3/16	7/32	1/4
	DEGREES OF SPRING BACK						
.018	9	10	13	14-1/2	18	18	20
.020	8-1/2	9-1/2	12-1/2	13-1/2	14-1/2	17	19
.025	8	9	11	12	13	15-1/2	16-1/2
.032	7	8	10	11	11-1/2	13-1/2	14-1/2
.036	6-1/2	7-1/2	9-1/2	10-1/2	11	12-1/2	13
.040	6	7	9	10	10	12	12
.051	5	6	8	9	9	10	10
.064	4	6	7	8	8	9	9
.072	3	5-1/2	6-1/2	7-1/2	8	8-1/2	9

DRAWN	CAME	10-15-56	SPRING BACK ALLOWANCE FOR 2024-T4 (ALUMINUM ALLOY) FOR HYDRO-PRESS FORMING  <b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	TOOL FABRICATION PROCEDURES MANUAL  PAGE 126
CHECKED	ROBBINS	10-20-56		
APPROVED				
APPROVED				



	COR-RES STEEL 57-136-9B SOFT						
MAT'L GAGE	R A D I U S						
	1/16	3/32	1/8	5/32	3/16	7/32	1/4
	DEGREES OF SPRING BACK						
.018	4 1/2	5 1/2	6 1/2	7 1/2	8 1/2	9	9 1/2
.020	4 1/2	5	6 1/2	7 1/2	8	9	9 1/2
.025	4	5	6	7	8	8 1/2	9
.032	3	4	5	6	7	7 1/2	8
.036	3	4	5	6	6 1/2	7	7 1/2
.040	2 1/2	3 1/2	4 1/2	5	6	6 1/2	7
.051		3	3 1/2	4 1/2	5	5 1/2	6
.064			3	3 1/2	4 1/2	5	5 1/2
.072				3	4	4 1/2	5

DRAWN	CAME 10-15-56	SPRING BACK ALLOWANCE FOR COR-RES STEEL 57-136-9B SOFT FOR HYDRO-PRESS FORMING	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 10-20-56		
APPROVED		<b>C O N V A I R</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 127
APPROVED			

COR-RES STEEL 11068 1/4 HARD							
MAT'L GAGE	R A D I U S						
	1/16	3/32	1/8	5/32	3/16	7/32	1/4
	DEGREES OF SPRING BACK						
.018	9-1/2	13	17	19	21	23	23-1/2
.020	9-1/2	13	15-1/2	17-1/2	19-1/2	21	23
.025	7-1/2	11-1/2	13-1/2	16	17	19-1/2	21
.032	5-1/2	11-1/2	13	15	15-1/2	17-1/2	19
.036		10-1/2	12-1/2	14-1/2	15	16	17
.040		10	11-1/2	13-1/2	14	15	16
.051			10-1/2	11-1/2	12-1/2	13-1/2	15
.064			10	10-1/2	11-1/2	12-1/2	13-1/2
.072				10	10-1/2	11-1/2	12-1/2

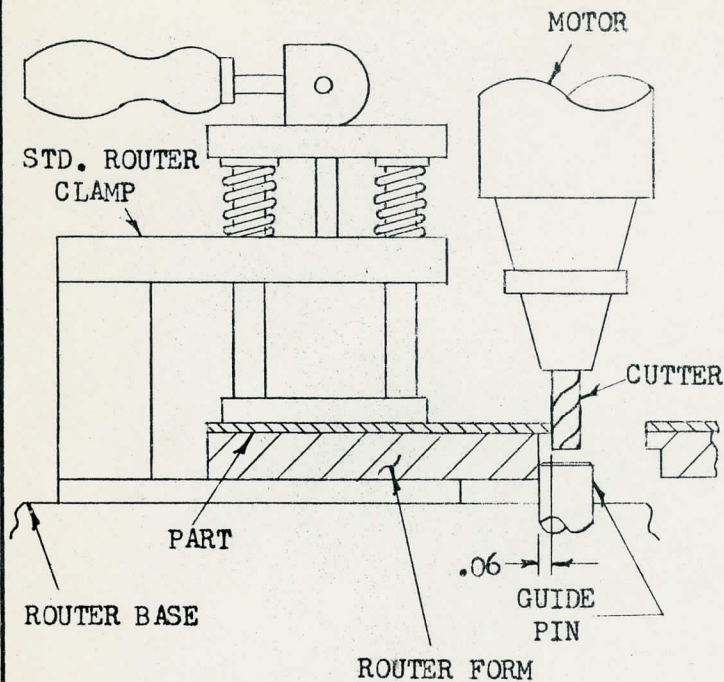
DRAWN	CAME 10-15-56	SPRING BACK ALLOWANCE FOR COR-RES STEEL 11068 1/4 HARD FOR HYDRO-PRESS FORMING	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 10-20-56		
APPROVED		<b>C O N V A I R</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> SAN DIEGO	PAGE 128
APPROVED			



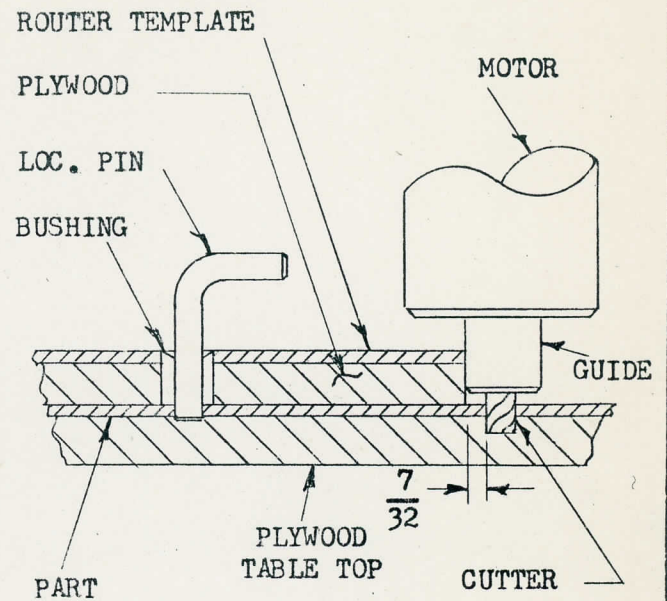
	COR-RES STEEL 11068-A 1/2 HARD						
MAT'L GAGE	R A D I U S						
	1/16	3/32	1/8	5/32	3/16	7/32	1/4
	DEGREES OF SPRING BACK						
.018	12	15	18-1/2	24	24-1/2	27-1/2	30
.020	12	15	18	21-1/2	24	27	27-1/2
.025	12	12-1/2	18	21	21-1/2	24-1/2	24-1/2
.032	9-1/2	12	15	18	18-1/2	21	21-1/2
.036	9-1/2	12	15	15-1/2	18	18-1/2	21
.040	9	9-1/2	12-1/2	15	15-1/2	18	18-1/2
.051			12	14	14-1/2	17	17
.064			11	12-1/2	13	13-1/2	15-1/2
.072				11	12	12-1/2	14

DRAWN	CAME 10-15-56	SPRING BACK ALLOWANCE FOR COR-RES STEEL 11068-A 1/2 HARD FOR HYDRO-PRESS FORMING	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 10-20-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> <small>SAN DIEGO</small>	PAGE 129
APPROVED			

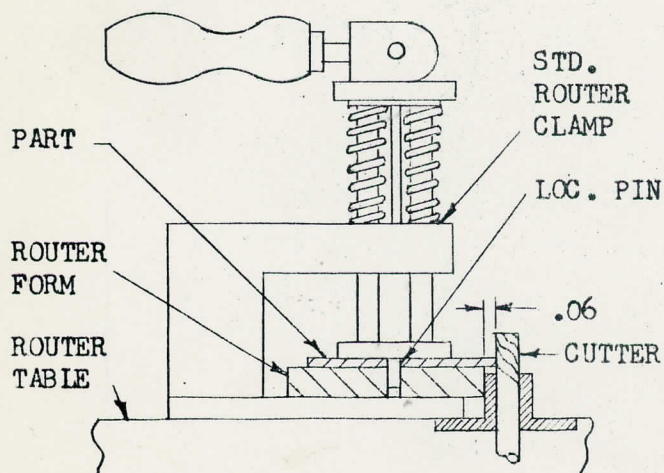
### PRINCIPLE OF OVERHEAD PIN ROUTER



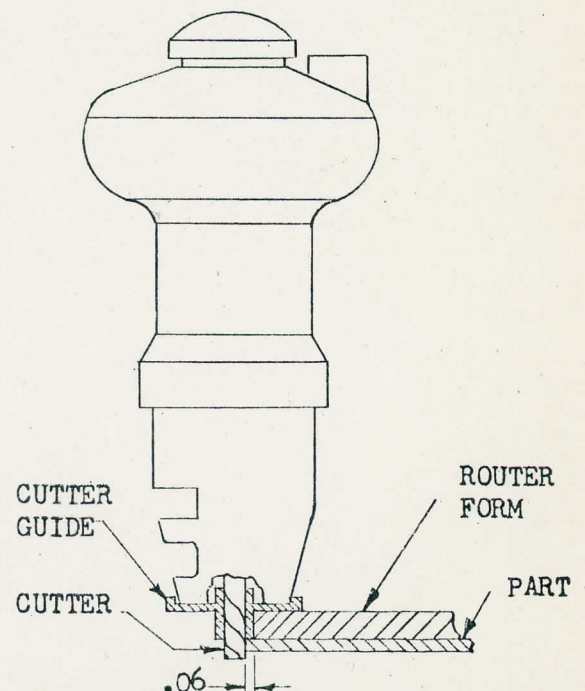
### PRINCIPLES OF RADIAL ARM ROUTER



### PRINCIPLE OF TABLE ROUTER



### PRINCIPLES OF PORTABLE ROUTER



DRAWN	STICKELMAN	1-9-57
CHECKED	ROBBINS	
APPROVED		
APPROVED		

PRINCIPLES OF OVERHEAD PIN,  
RADIAL ARM, TABLE & PORTABLE ROUTERS

CONVAIR

SAN DIEGO

TOOL FABRICATION  
PROCEDURES  
MANUAL

PAGE 133



### SHAPER ROUTING

THIS METHOD OF ROUTING CONSISTS OF A FIXED POSITION ROUTING CUTTER IN THE CENTER OF A TABLE WITH PERIMETERS CONTROLLED BY A ROUTER FORM (RTFM).

THIS MACHINE IS NOT ADAPTABLE TO INTERNAL PERIPHERY ROUTING UNLESS A 3/4" HOLE IS PUNCHED WITHIN THE INTERNAL PERIPHERY. WHERE INTERNAL PERIPHERIES EXCEED MAXIMUM MATERIAL DIMENSIONS FOR PIN ROUTER, THE PLANNING SHALL CALL FOR PUNCHING THE REQUIRED 3/4" STARTING HOLE.

ROUTER FORMS SHOULD BE PLANNED TO LOCATE STOCK BY MEANS OF LOCATING PINS.

WHERE A FORMED PART IS TO BE ROUTED, DRILL BUSHINGS MAY BE ORDERED IN A RTFM FOR TOOLING PIN LOCATION, A TOTP FOR HOLE LOCATION SHOULD BE ORDERED.

A SET BACK OF .062 IS TO BE INCORPORATED IN RTFM TO COMPENSATE FOR DIFFERENCE IN DIAMETER OF BUSHING AND CUTTER.

### OVERHEAD OR PIN ROUTING

THIS METHOD CONSISTS OF A FIXED POSITION ROUTING CUTTER WHERE THE INTERNAL PERIMETERS ARE CONTROLLED BY THE BOTTOM EDGE OF THE ROUTER FORM AND A PIN IN THE TABLE OF THE ROUTING TABLE.

THIS ROUTER MAY BE USED FOR PREPARATION OF BLANKS FOR TRIMMING AFTER FORMING, PROVIDED THE STOCK SIZES DO NOT EXCEED THE MINIMUM SIZES FOR RADIAL ROUTER.

THIS SYSTEM DOES NOT REQUIRE A STARTING HOLE IN THE PART. THE ROUTER CUTTER IS USED AS A DRILL.

A SET BACK OF .062 IS TO BE INCORPORATED IN RTFM TO COMPENSATE FOR DIFFERENCE IN DIAMETERS OF GUIDE PIN AND ROUTER CUTTERS. (THIS DIFFERENCE IS MAINTAINED SO RTFM SET-BACK WILL BE SAME FOR SHAPER AND PIN-ROUTING).

### PORTABLE ROUTERS

THIS METHOD USES A PORTABLE ROUTER GUIDED BY HAND FOLLOWING A ROUTER FORM (RTFM) OR TRIM SHELL (TRSH). THIS METHOD IS USED FOR ROUTING CONTOURED PARTS THAT CANNOT BE DONE ON A MACHINE AND IS ALSO USED FOR TRIMMING OPERATIONS ON ASSEMBLIES.

NOSE PIECE OF ROUTER CARRIES A BUSHING WITH CUTTER GOING THROUGH BUSHING. O.D. OF BUSHING ACTS AS A FOLLOWER ON RTFM OR TRSH WHICH HAVE AN .062 SET BACK INCORPORATED IN THEM TO COMPENSATE FOR DIFFERENCE IN DIAMETER OF CUTTER AND BUSHING.

### RADIAL ARM ROUTER

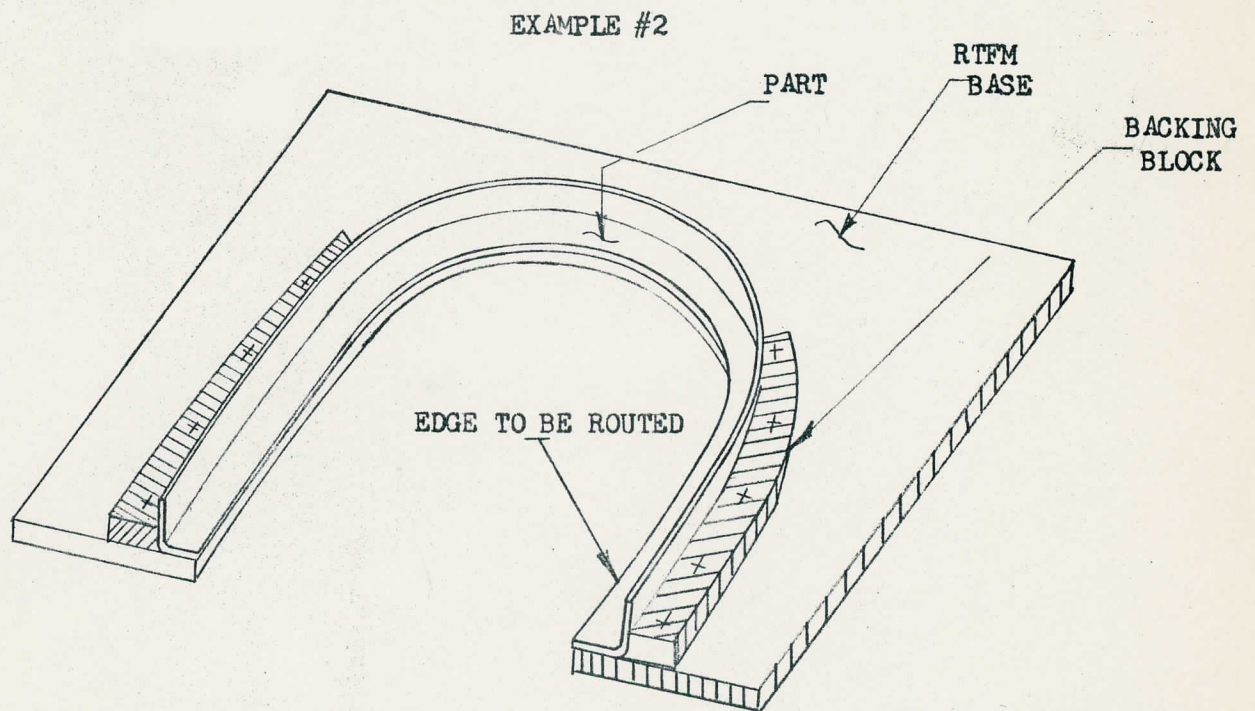
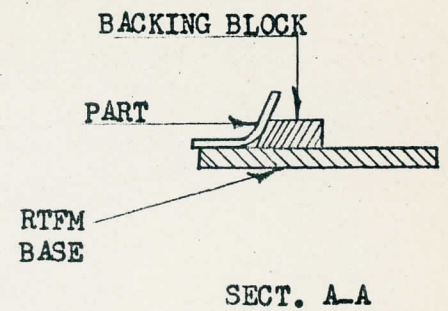
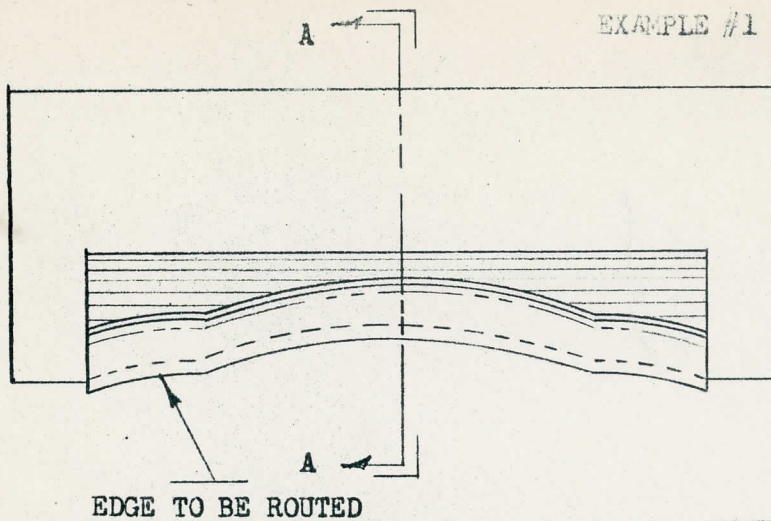
THIS METHOD USES ROUTER MOTOR CARRIED ON A JOINTED RADIAL ARM. A NOSE PIECE ATTACHED TO MOTOR CARRIES A BUSHING WHICH RIDES AGAINST ROUTER TEMPLATE (RTTP) SPACED ABOVE PARTS BEING ROUTED BY PLYWOOD SEPARATOR. ROUTER CUTTER GOES THRU GUIDE BUSHING AND AN OFFSET OF 7/32 IS USED ON THIS TYPE ROUTING TO COMPENSATE FOR DIFFERENCE IN DIAMETER OF BUSHING AND CUTTER.

THIS METHOD IS USED ON LARGE PARTS NOT LESS THAN 4.0 WIDE AND NOT LESS THAN 100.0 TOTAL EXTERNAL PERIMETER AND CAN ALSO BE USED TO ROUT CUT-OUTS.

NOTE: ALL ROUTER FORMS TO HAVE PERIPHERY WITNESS STAMPED BY TOOL INSPECTION.

DRAWN	CAME 10-26-56	ROUTER FORMS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS		
APPROVED			
APPROVED		CONVAIR <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 134



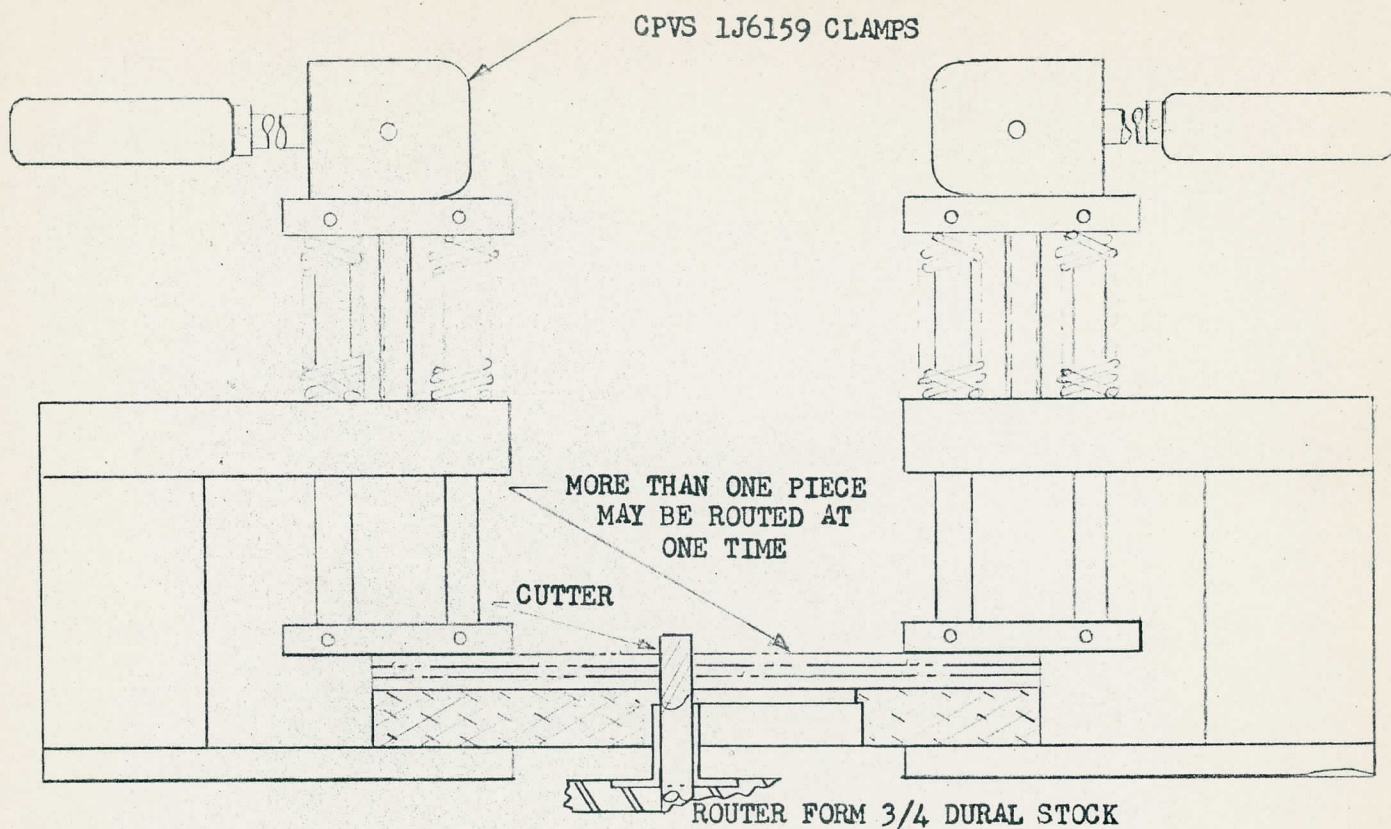


PROVIDE BACKING BLOCK ON RTFM'S TO GIVE MORE POSITIVE LOCATION AND ADDED SUPPORT AND RIGIDITY TO THE PART DURING THE ROUTING OPERATION.

MAKE BLOCK OF HARDWOOD OR CAST DURAL.

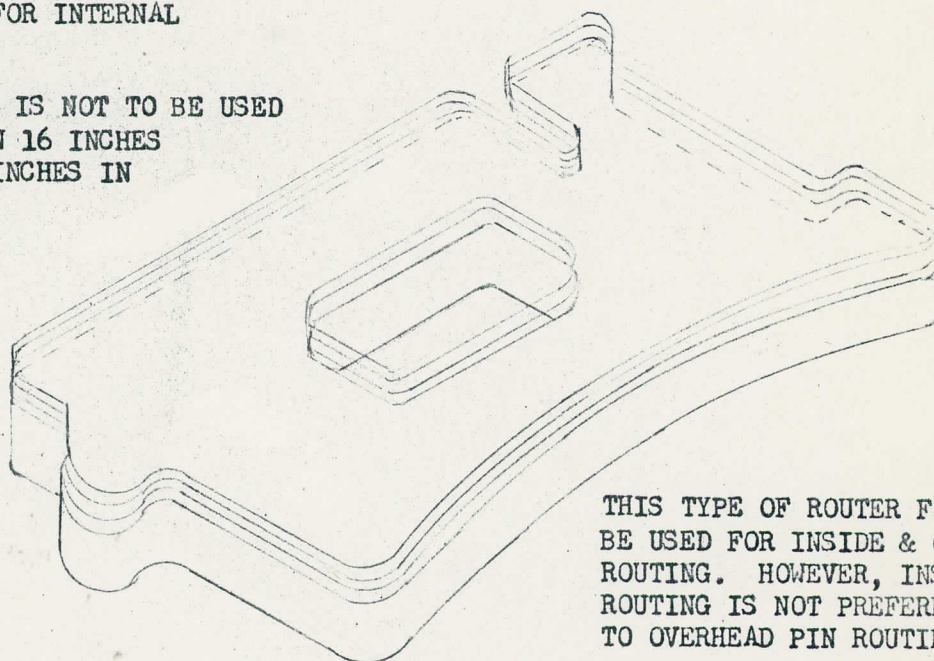
DRAWN	CAME 10-26-56	ROUTER FORM "RTFM" TOOL ILLUSTRATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 135
APPROVED			





A 3/4 HOLE MUST BE PROVIDED  
AS STARTING HOLE FOR INTERNAL  
PERIMETER.

NOTE: 1. THIS TOOL IS NOT TO BE USED  
ON PARTS LESS THAN 16 INCHES  
OR MORE THAN 100 INCHES IN  
PERIMETER.

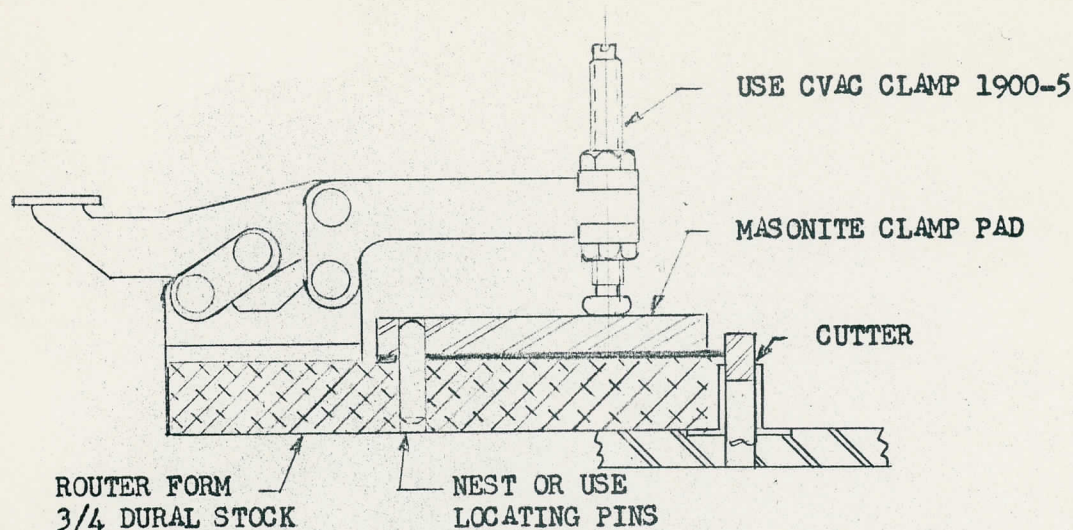


THIS TYPE OF ROUTER FORM MAY  
BE USED FOR INSIDE & OUTSIDE  
ROUTING. HOWEVER, INSIDE  
ROUTING IS NOT PREFERRED (REF.  
TO OVERHEAD PIN ROUTING).

TYPICAL ROUTER FORM

DRAWN	CAME 10-29-56	ROUTER FORM - STACK ROUTING USED ON SHAPER	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 136
APPROVED			



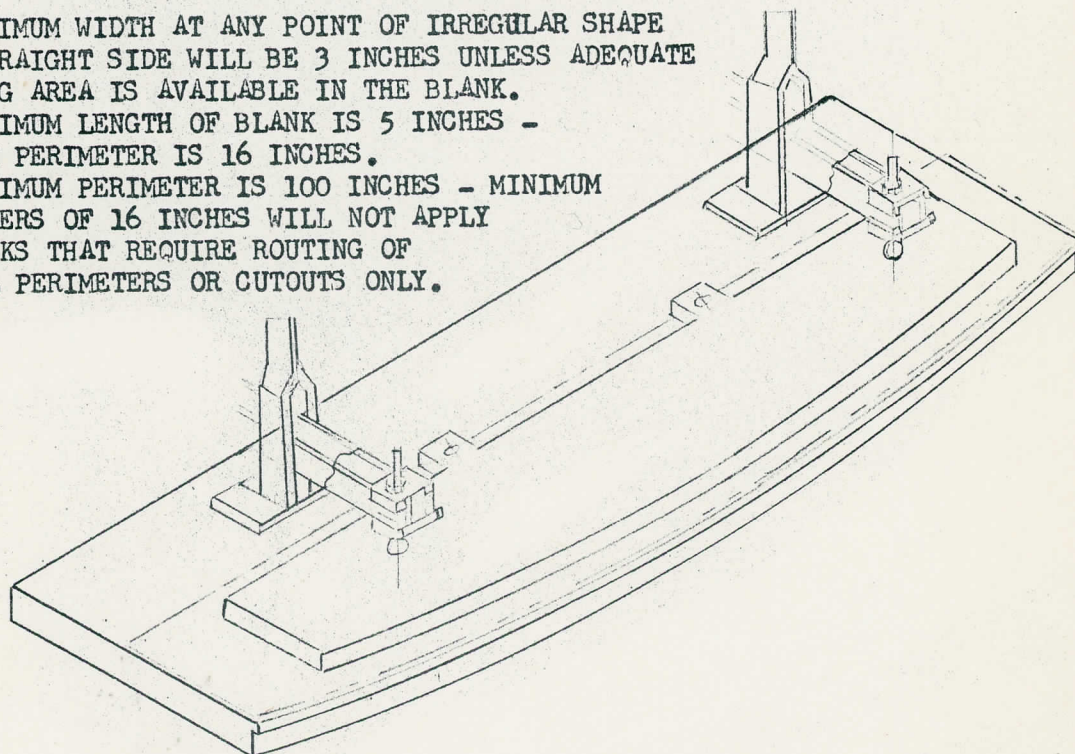


**NOTE:**

1. MINIMUM WIDTH AT ANY POINT OF IRREGULAR SHAPE TO A STRAIGHT SIDE WILL BE 3 INCHES UNLESS ADEQUATE CLAMPING AREA IS AVAILABLE IN THE BLANK.

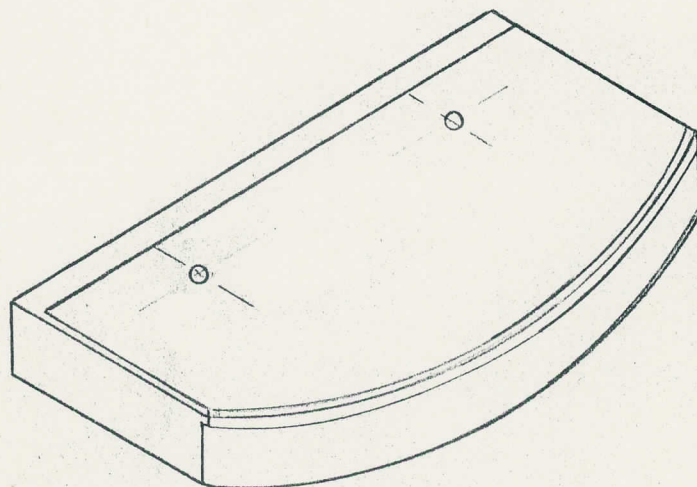
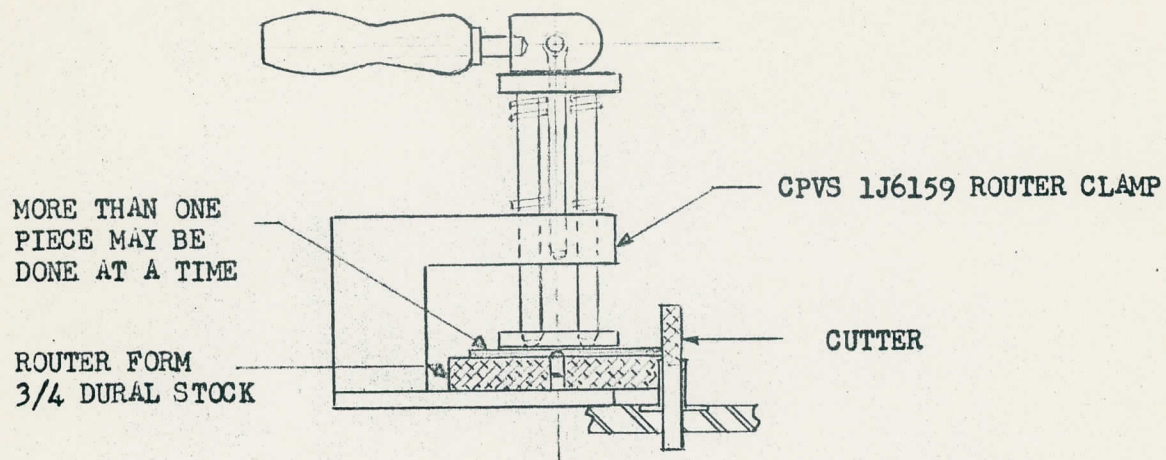
MINIMUM LENGTH OF BLANK IS 5 INCHES -  
MINIMUM PERIMETER IS 16 INCHES.

MAXIMUM PERIMETER IS 100 INCHES - MINIMUM PERIMETERS OF 16 INCHES WILL NOT APPLY TO BLANKS THAT REQUIRE ROUTING OF PARTIAL PERIMETERS OR CUTOUTS ONLY.



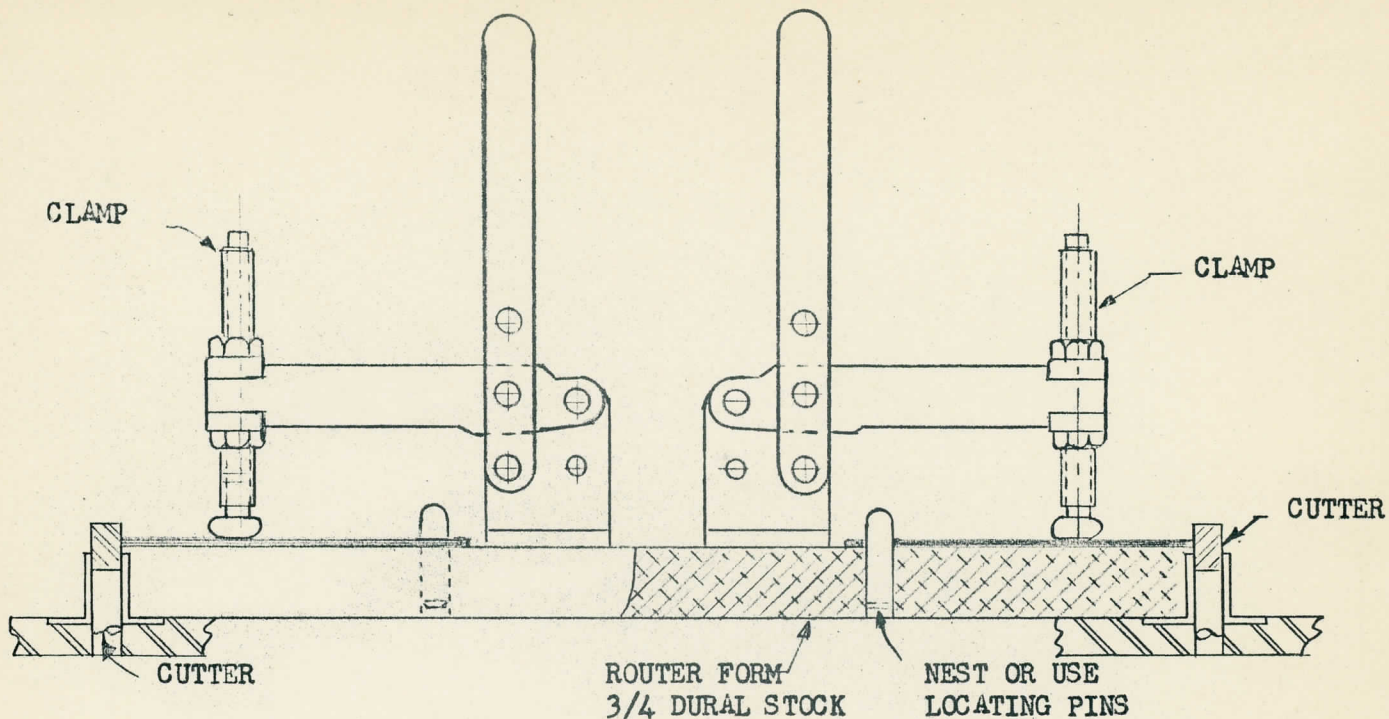
DRAWN	CAME 10-29-56	ROUTER FORM USED FOR LONG NARROW PARTS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 137
APPROVED			





**NOTE:** 1. THIS TOOL NOT TO BE USED ON PARTS LESS THAN 16 INCHES  
OR MORE THAN 100 INCHES IN PERMIETER.

DRAWN	CAME 10-29-56	ROUTER FORM USED ON SHAPER	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 138
APPROVED			



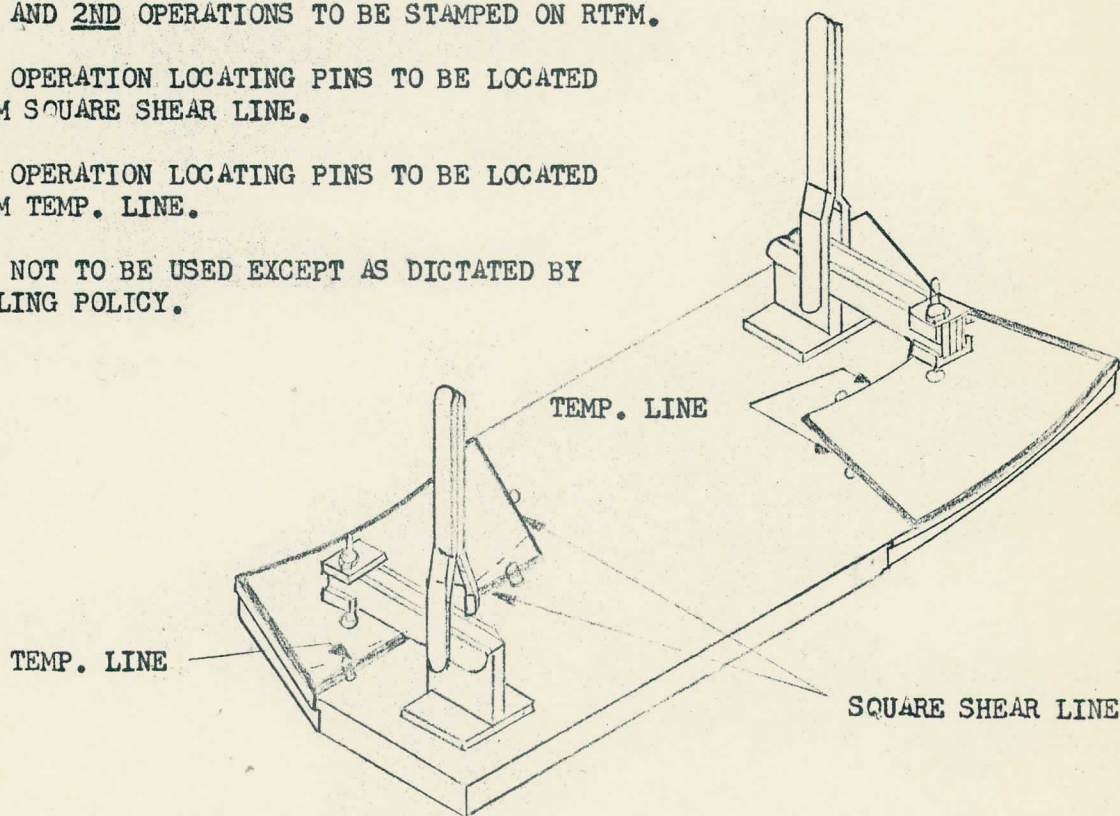
**NOTE:**

1ST AND 2ND OPERATIONS TO BE STAMPED ON RTFM.

1ST OPERATION LOCATING PINS TO BE LOCATED FROM SQUARE SHEAR LINE.

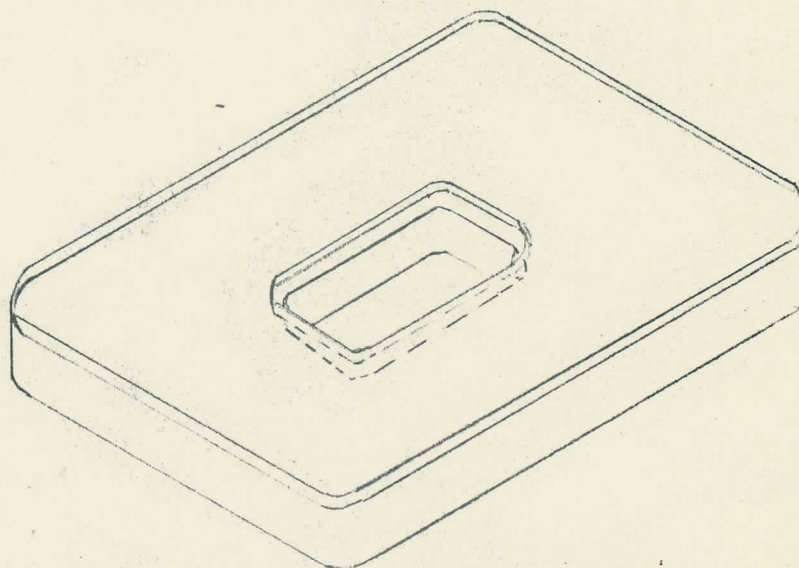
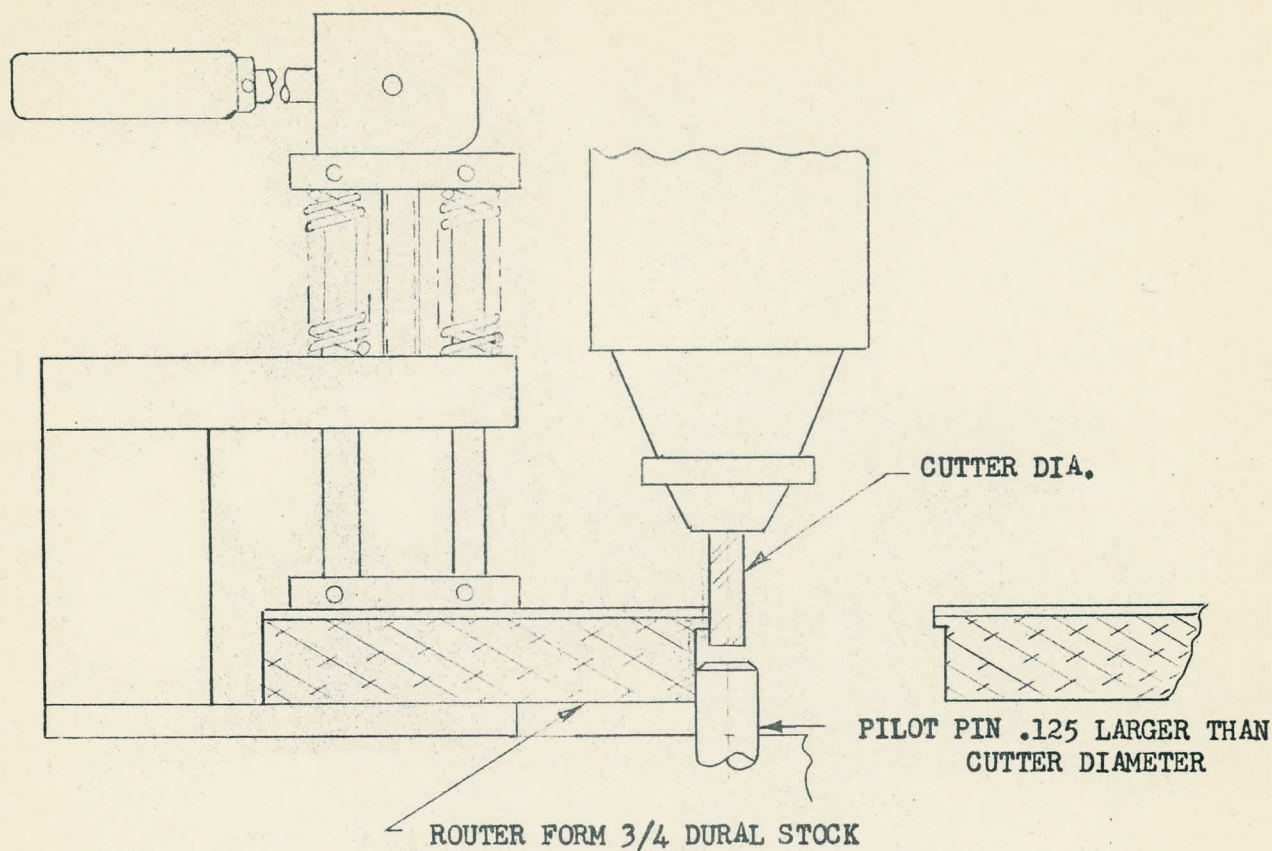
2ND OPERATION LOCATING PINS TO BE LOCATED FROM TEMP. LINE.

3 NOT TO BE USED EXCEPT AS DICTATED BY TOOLING POLICY.



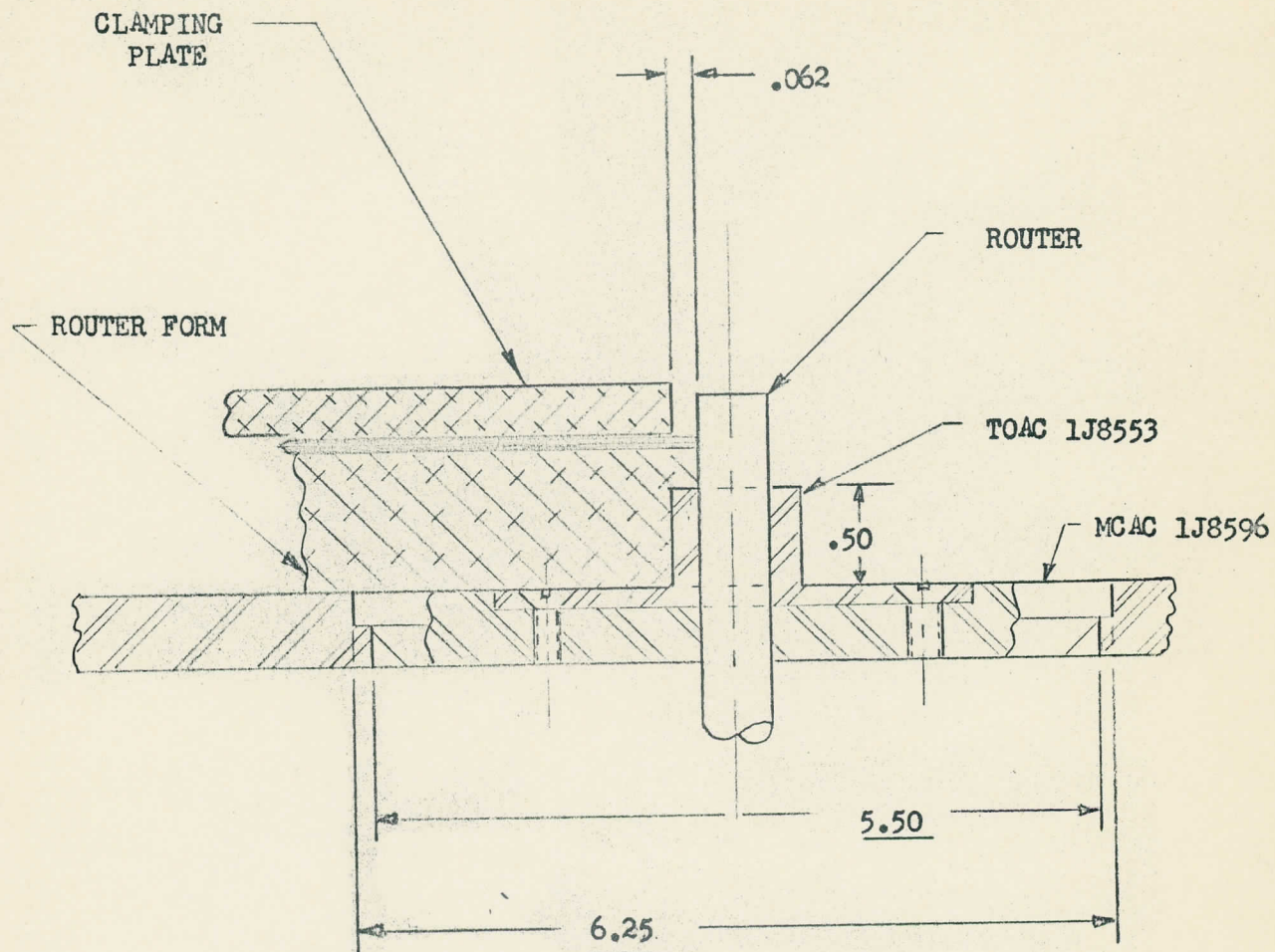
DRAWN	CAME 10-29-56	ROUTER FORM USED FOR STOCK UNDER 3" X 5" DIM.	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 139
APPROVED			





**NOTE:** USED ON ONSTRUD OVERHEAD ROUTER, THIS IS THE PREFERRED METHOD OF ROUTING INSIDE PERIMETERS.

DRAWN	CAME 10-29-56	OVERHEAD ROUTING	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 140
APPROVED			

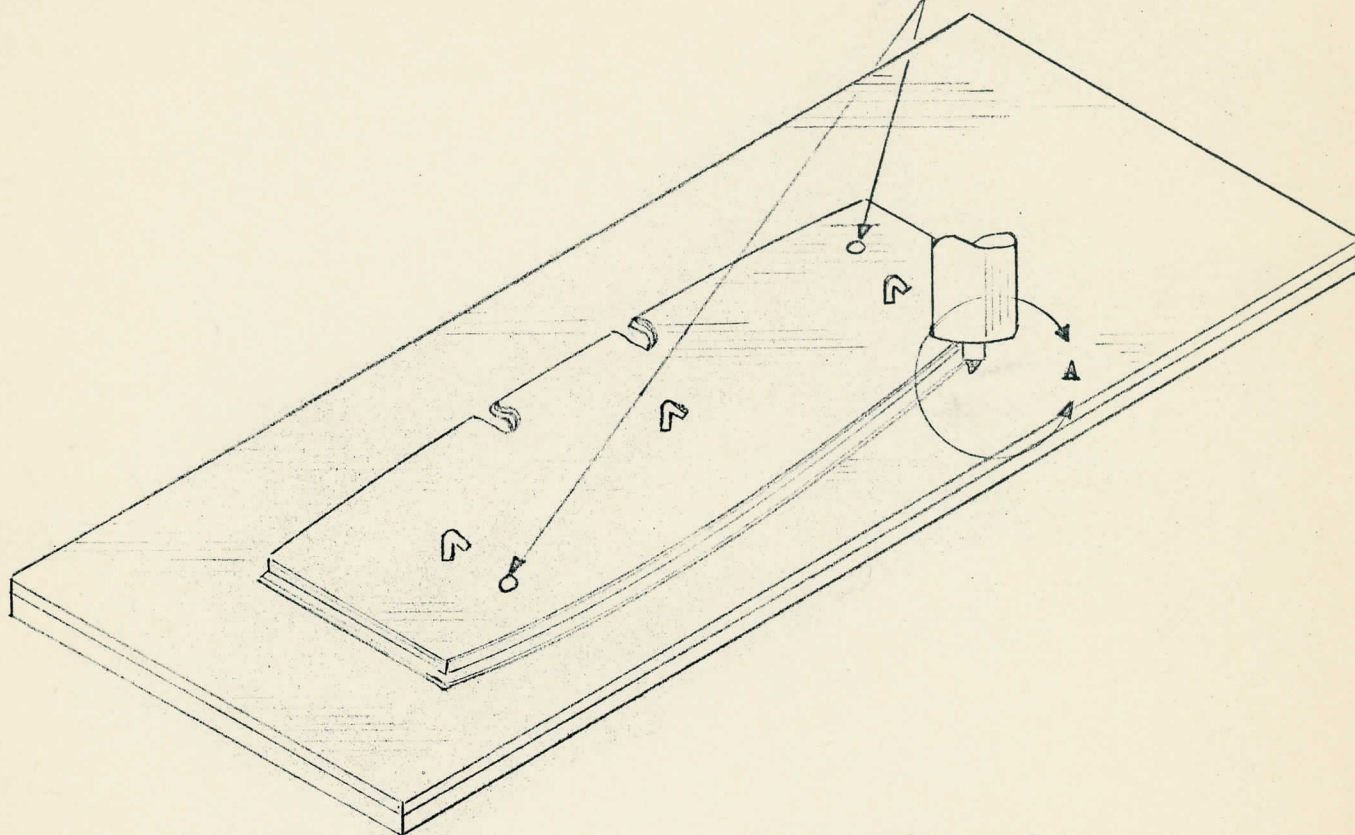


NOTE: .062 STEP TO BE MAINTAINED ON ALL TABLE ROUTER FORMS.

DRAWN	CAME 10-29-56	TYPICAL APPLICATIONS FOR ROUTERS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 141
APPROVED			



FOR GREATER EASE IN INSPECTING RTTP. THE PROD TEMP.  
AND RTTP SHOULD HAVE TWO 1/4" DIA. COORDINATED TOOLING  
HOLES FOR CHECKING 13/64" OFFSET OF RTTP.



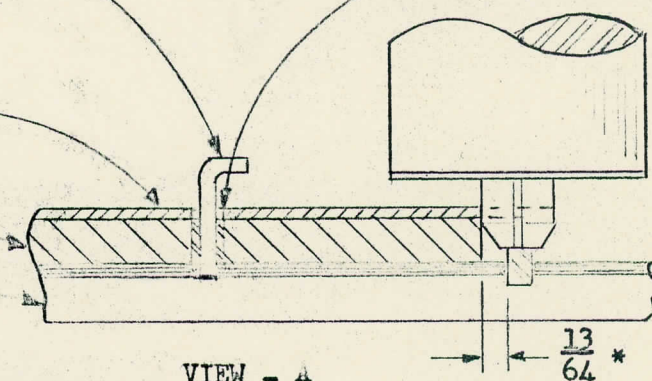
PULL TYPE LOCATING PINS  
REF. TOOL PLANNING

STD. 1900 BUSHING

ROUTER TEMPLATE  
1/4" 24ST AL. AL.

1/2" PLYWOOD

PLYWOOD  
TABLE TOP



VIEW - A

$\frac{13}{64}$  \*

**NOTE:**

THIS ROUTER CAN BE USED FOR  
ROUTING INTERNAL PERIMETERS.  
IT IS NOT USED ON STOCK LESS  
THAN 4" WIDE & NOT LESS THAN 100"  
TOTAL EXTERNAL PERIMETER.

\* NOTE: NOMINAL DIM IS 7/32,  
BUT THIS DIM. IS USED TO ADD  
1/64 TO THE TOOL FOR WEAR  
ALLOWANCE.

DRAWN	CAME 10-29-56	ROUTING LARGE SHEETS RADIAL METHOD	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 142
APPROVED			

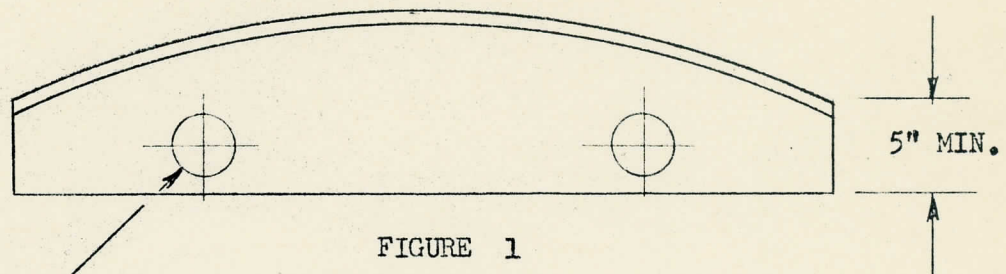


FIGURE 1

4.19 DIA. HOLES IN STFM'S TO BE USED ON A12 HUFFORD  
3.19 DIA. HOLES IN STFM'S USED ON OTHER MACHINES

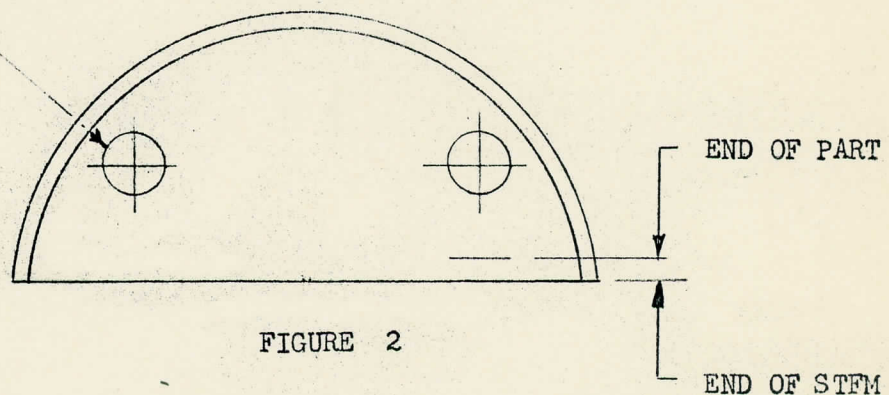


FIGURE 2

THE DEPTH OF THE STFM IS DETERMINED BY A NUMBER OF FACTORS, SUCH AS THE LOCATION OF THE MOUNTING HOLES, THE RADIUS AND DEGREE OF BEND, ETC. A BASIC FORMULA TO FOLLOW IS TO MAINTAIN A 5" MIN. DEPTH AT THE END OF THE FORM FOR LARGE RADIUS AND SMALL ANGLES (FIG 1) FOR SMALLER RADII AND LARGE DEGREE OF BENDS (FIG 2). THE BASIC RULE OF CUTTING THE END OF THE FORM 1" FROM THE END OF THE PART MUST BE HELD. MOUNTING HOLES SHALL BE PLACED IN THE FORM BY CONVAIR.

DRILL AND TAP STFM FOR EYEBOLTS TO FACILITATE HANDLING. DETERMINE SIZE FOR WEIGHT AND SIZE OF STFM.

EYE BOLTS AVAILABLE ARE:

1/2-13	CVAC	BOL	1705-5
5/8-11	CVAC	BOL	
3/4-10	CVAC	BOL	1705-10

DRAWN	CAME 11-1-56	STFM DATE	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 146
APPROVED			



MATERIAL FOR STRETCHER FORMS

PLYWOOD SHOULD BE USED FOR STFM'S WHEN ALL THE FOLLOWING  
CONDITIONS EXIST:

1. WHEN MAKING 12 PARTS OR LESS.
2. WHEN THICKNESS OF PART IS .090 OR LESS.
3. WHEN LENGTH OF PART IS 6 FEET OF LESS.
4. WHEN CHORD HEIGHT OF CONTOUR IS 6 INCHES  
OR LESS.

USE CAST DURAL AND/OR HI'DEN FOR ALL OTHER CONDITIONS.

DRAWN	CAME 10-29-56	MATERIAL FOR STRETCHER FORMS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 147
APPROVED			

## STRETCH FORM LAYOUT PROCEDURE

### 1. SYMMETRICAL STRETCH FORMS

LAYOUT PLAN VIEW OF SYMMETRICAL PART FORM WITH ITS CENTER LINE AND ADD NECESSARY TRIM TANGENT TO ENDS OF PART AT BOTH ENDS, AS SHOWN IN ILLUSTRATION ON FOLLOWING PAGE.

DRAW A LINE THROUGH THESE POINTS AND PERPENDICULAR TO THE CENTER LINE. CALL THIS THE "TRIM LINE".

ALL A MARGIN BEYOND "TRIM LINE" TO PROVIDE EXTRA MATERIAL IN THE EVENT THAT A CORRECTION IS NECESSARY DUE TO SPRINGBACK. THIS MARGIN SHOULD BE A MINIMUM OF 2.00 ON DEEP STRETCH FORMS AND INCREASED TO WIDTH NECESSARY FOR STRENGTH ON EXTREMELY SHALLOW DIES. THIS MARGIN LINE MUST BE PARALLEL TO "TRIM LINE" AND INTERSECT TANGENTS OF THE FORM CURVE. CALL THIS THE "FORM LINE".

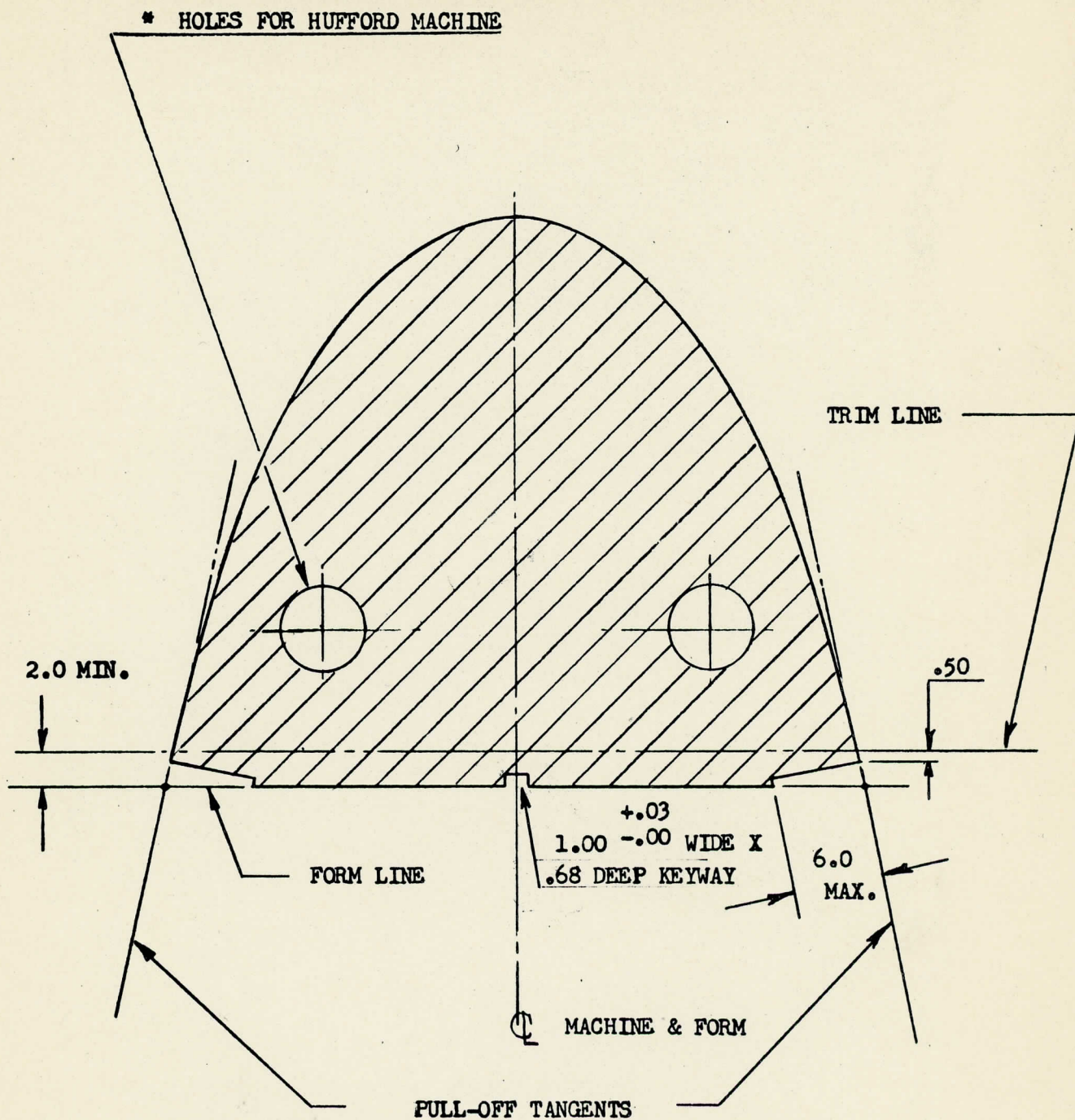
AFTER THE STRETCH FORM HAS BEEN TRIED OUT AND CORRECTED FOR SPRINGBACK IF NECESSARY, THE STRETCH FORM ENDS ARE CUT BACK AT .50 BEYOND TRIM LINE. THIS CUT-BACK IS MADE PERPENDICULAR TO PULL-OFF TANGENT LINE TO CLEAR EXTRUSION JAWS AND THEREBY REDUCE EXTRA STOCK BEYOND ACTUAL PART LENGTH TO A MINIMUM. WHEN THIS PERPENDICULAR CUT DOES NOT INTERSECT THE FORM LINE WITHIN 6.00, THE CUT IS STOPPED AT 6.00 AND ANOTHER CUT IS MADE PERPENDICULAR TO FIRST CUT AND INTERSECTING THE "FORM LINE".

THE SHADED AREA IN FOLLOWING ILLUSTRATION IS AN EXAMPLE OF A COMPLETED SYMMETRICAL FORM DIE.

NOTE: REFER TO TOOL ENGINEERING EQUIPMENT & DESIGN DATA MANUAL FOR MACHINE CAPACITIES, MAXIMUM DIE SIZES AT DIFFERENT ARM POSITIONS.  
PAGES 7.16.01 TO 7.16.08

DRAWN	ROBBINS 4-10-56	LAYOUT PROCEDURE - SYM. STRETCH FORMS SHERIDAN E 40-12	TOOL FABRICATION PROCEDURES MANUAL
CHECKED			
APPROVED			
APPROVED	CONNELL 4-10-56	CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 148





\* HOLES FOR HUFFORD MOUNTING TO BE PUT IN STFM'S FOR SHERIDAN SO STFM CAN BE USED ON EITHER MACHINE.

DRAWN	ROBBINS 4-10-56	SYMMETRICAL STRETCH FORMS SHERIDAN E 40-12	TOOL FABRICATION PROCEDURES MANUAL
CHECKED			
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 149
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## STRETCH FORM LAYOUT PROCEDURE

### 2. NON-SYMMETRICAL STRETCH FORMS:

THE NON-SYMMETRICAL STRETCH FORM CAPACITY OF THIS MACHINE FALLS WITHIN SAME SIZE LIMITS AS SHOWN FOR SYMMETRICAL DIES, BUT LAYOUT IS FURTHER DETERMINED BY THE RATIO OF THE TWO PULL-OFF ANGLES. THE LIMITATIONS IN SIZE OF PARTS INCREASES AS THE DIFFERENCE IN PULL OFF ANGLES BECOMES GREATER.

IT IS DESIRABLE TO HAVE AN ACCURATE LAYOUT OF THE ARCS OF TENSION CYLINDER TRUNNIONS TOGETHER WITH THE LINE OF DIE SUPPORT FACE AT MAXIMUM STROKE POSITION. THIS LAYOUT TO BE A CONVENIENT SCALE SIZE; REFER TO PREVIOUS PAGES FOR DIMENSIONS.

LAYOUT PLAN VIEW OF PART, FIGURE #1, USING SAME SCALE AS FOR ABOVE LAYOUT OF MACHINE.

CONSTRUCT PULL-OFF TANGENT LINES AT BOTH ENDS AND INCLUDE LENGTH OF TRIM ALLOWANCE ON THESE LINES. DRAW A LINE THROUGH THESE POINTS AND CALL THIS THE "TRIM LINE". ADD A MARGIN BEYOND THE "TRIM LINE" TO PROVIDE EXTRA MATERIAL IN THE EVENT CORRECTION FOR SPRINGBACK IS NECESSARY. THIS MARGIN SHOULD BE A MINIMUM OF 2.00 AND INCREASED AS NECESSARY FOR STRENGTH REQUIRED ON SHALLOW SHRETCH FORMS. THIS LINE MUST BE PARALLEL TO "TRIM LINE" AND INTERSECT THE TANGENTS OF FORM CURVE AT BOTH ENDS. CALL THIS THE "FORM LINE" MARK THE INTERSECTION AT THE MINOR ANGLE "A" AND AT THE OPPOSITE END "B".

DRAW A TANGENT ACROSS THE FRONT FACE OF THE FORM CURVE PARALLEL TO "FORM LINE". CALL THIS THE "FACE LINE". NOTE WHERE THE "FACE LINE" INTERSECTS THE PULL-OFF TANGENT LINES. FIND THE POINT MIDWAY ALONG THE "FACE LINE" AND MARK THIS "C". DRAW A LINE THROUGH "C" AND PERPENDICULAR TO THE "FORM LINE".

DISTANCE "X" OR DISTANCE FROM LINE THROUGH "G" TO NEAREST END OF FORM, MUST BE AT LEAST A MINIMUM DIMENSION FOR EACH DIFFERENT ARM POSITION AS LISTED BELOW. IF IT IS NOT, THEN RELOCATE LINE TO MINIMUM DIMENSION AND PARALLEL TO LINE THROUGH "C". THIS LINE EITHER THROUGH POINT "C", OR AS RELOCATED, NOW REFERENCES CENTER LINE OF MACHINE.

<u>ARM POSITION</u>	<u>"X" MINIMUM DIMENSION</u>
#1	10.50
#2	42.00
#3	71.00

EXTEND PULL-OFF TANGENT LINES BELOW INTERSECTION WITH "TRIM LINE" FOR A DISTANCE OF 21.00 PLUS 5% OF TOTAL LENGTH OF PART BEING FORMED. THIS REPRESENTS DISTANCE FROM CENTER LINE OF TENSION CYLINDER TRUNNIONS TO FACE OF JAW. LEAVING ENOUGH STROKE IN CYLINDER FOR FINAL STRETCHING OF PART. THIS DISTANCE "Y" IS SAME AT BOTH ENDS.

DRAWN	CAME 11-1-56	LAYOUT PROCEDURE NON-SYMMETRICAL FORMS - SHERIDAN	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-5-56		
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APPROVED			



## STRETCH FORM LAYOUT PROCEDURE - CONT.

BEYOND LENGTH "Y" AND ALONG SAME TANGENT LINES, MARK OFF A DISTANCE OF 30.00 MINUS THE 5% OF TOTAL PART LENGTH, WHICH REPRESENTS THE REMAINING TENSION CYLINDER STROKE. CALL THESE LENGTHS "Z".

SUPERIMPOSE FORM LAYOUT ON LAYOUT OF TENSION CYLINDER ARCS, WITH CENTER LINE COINCIDENT. MOVE "FORM LINE" OF STRETCH FORM LAYOUT BETWEEN THE AREA CREATED BY THE LINE OF MAXIMUM DIE TABLE STROKE AND A PARALLEL LINE THROUGH THE OUT-BOARD POINTS OF TENSION CYLINDER ARCS. IF LENGTHS "Z" EITHER INTERSECT OR BECOME TANGENT TO THE TENSION CYLINDER TRUNNION ARCS SIMULTANEOUSLY AT ANY POINT ALONG THIS LINE, THE STRETCH FORM IS READILY ADAPTABLE TO MACHINE.

HOWEVER, IF ONE LEG OR OTHER ALONG LENGTH "Z" OF STRETCH FORM FAILS TO JOIN OR INTERSECT THE ARCS OF TRUNNIONS, ROTATE STRETCHER FORM ABOUT POINT "C", UNTIL BOTH LEGS "Z" INTERSECT THE ARCS. ANY INCREASE IN ROTATION WILL INCREASE SIZE OF STRETCH FORM BUT CARE MUST BE TAKEN IN USING THE EXTREMES OF EITHER ENDS OF "Z", REPRESENTING THE STROKE REMAINING IN TENSION CYLINDERS.

FIGURE 2 SHOWS A DIE FORM ROTATED ABOUT POINT "C" UNTIL BOTH ITS LENGTHS "Z" SIMULTANEOUSLY INTERSECT TRUNNION ARCS.

RELOCATE "FORM LINE" PERPENDICULAR TO  $\phi$  OF THE MACHINE, FROM POINT "A" TO "D". DRAW FACE LINE TANGENT TO STRETCH FORM AND PARALLEL TO NEW "FORM LINE". LOCATE POINT "E" ON FACE LINE AND MIDPOINT OF INTERSECTION WITH PULL-OFF TANGENTS. DRAW A LINE THROUGH POINT "E" AND PERPENDICULAR TO FORM LINE. THIS LINE REFERENCES CENTER LINE OF MACHINE AND NEW STRETCH FORM.

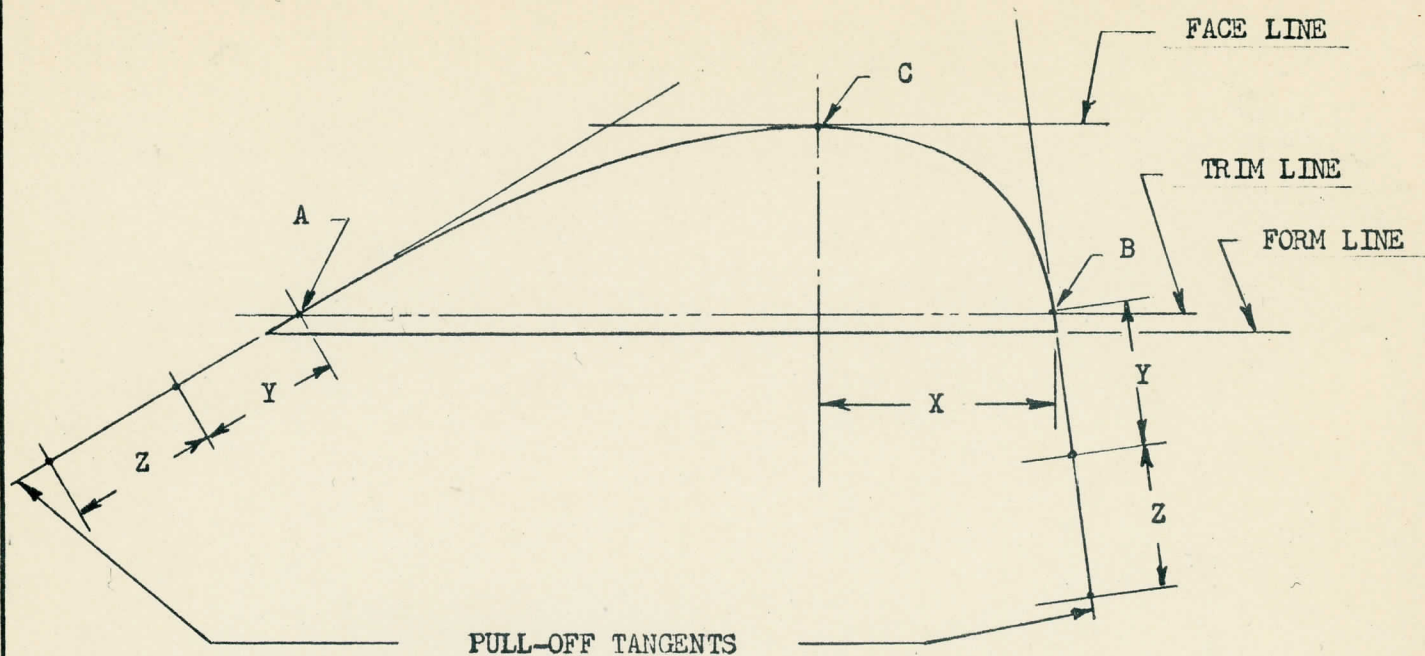
ALIGN CENTER LINE OF NEW STRETCH FORM WITH CENTER LINE OF LAYOUT OF MACHINE AS BEFORE. CHECK TO SEE THAT BOTH LENGTHS "Z" INTERSECT TRUNNION ARCS WITHIN DIE TABLE STROKE AREA AS BEFORE. DUE TO SHIFTING THE CENTER LINE, ONE OF THE LENGTHS "Z" MAY AGAIN BE SHORT OF INTERSECTING TRUNNION ARC. REPEAT PROCESS IF NECESSARY UNTIL CORRECTED STRETCH FORM IS ACHIEVED.

AFTER STRETCH FORM HAS BEEN TRIED OUT AND CORRECTED FOR SPRING BACK IF NECESSARY, THE DIE ENDS ARE CUT BACK .50 BEYOND THE TRIM LINE. THIS CUT OFF IS MADE PERPENDICULAR TO PULL-OFF TANGENT AND NOT TO EXCEED 6.00. IF CUT DOES NOT INTERSECT "FORM LINE" WITHIN 6.00 IT IS TERMINATED AT 6.00 AND ANOTHER CUT PERPENDICULAR TO IT AND INTERSECTING "FORM LINE" IS MADE.

SHADED AREA SHOWN IN FIGURE #2 SHOWS COMPLETED NON-SYMMETRICAL STRETCH FORM EXCEPT KEY WAY WHICH IS TO BE 1.00  $\pm .03$  WIDE X .68 DEEP TO FALL ON  $\phi$  OF MACHINE. ALSO HOLES SHOULD BE ADDED FOR USING ON HUFFORD MACHINE SO THAT STRETCH FORM MAY BE USED ON EITHER MACHINE.

DRAWN	CAME 11-1-56	LAYOUT PROCEDURE NON-SYMMETRICAL - SHERIDAN	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-5		
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APPROVED			





$Y = 21.00 + 5\% \text{ OF PART LENGTH}$

$Z = 30.00 - 5\% \text{ OF PART LENGTH}$

FIGURE # 1

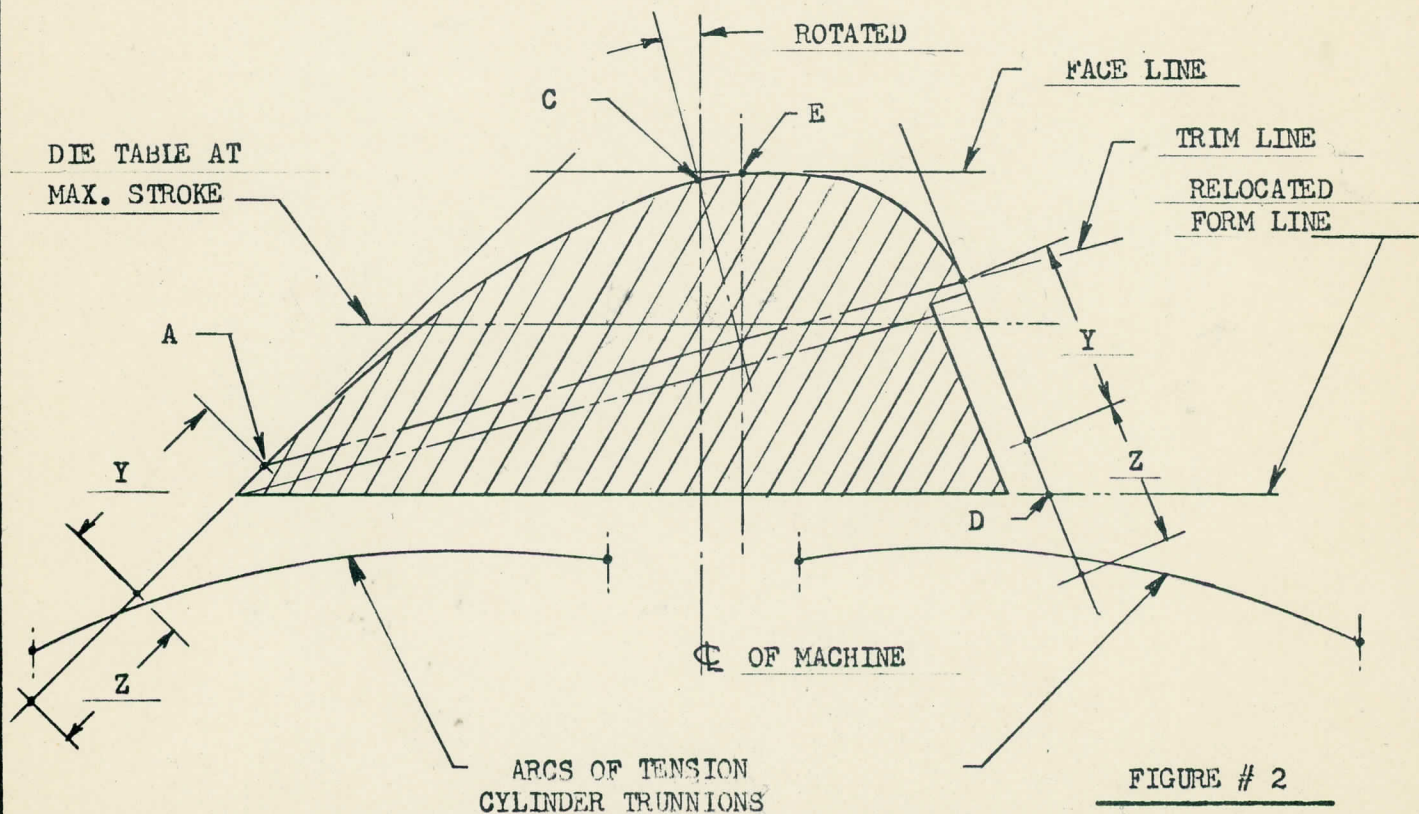


FIGURE # 2

DRAWN	ROBBINS 4-10-56	NON - SYMMETRICAL STRETCH FORMS SHERIDAN E 40-12	TOOL FABRICATION PROCEDURES MANUAL
CHECKED			
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## POSITIVE POSITION FORMING TEMPLATE

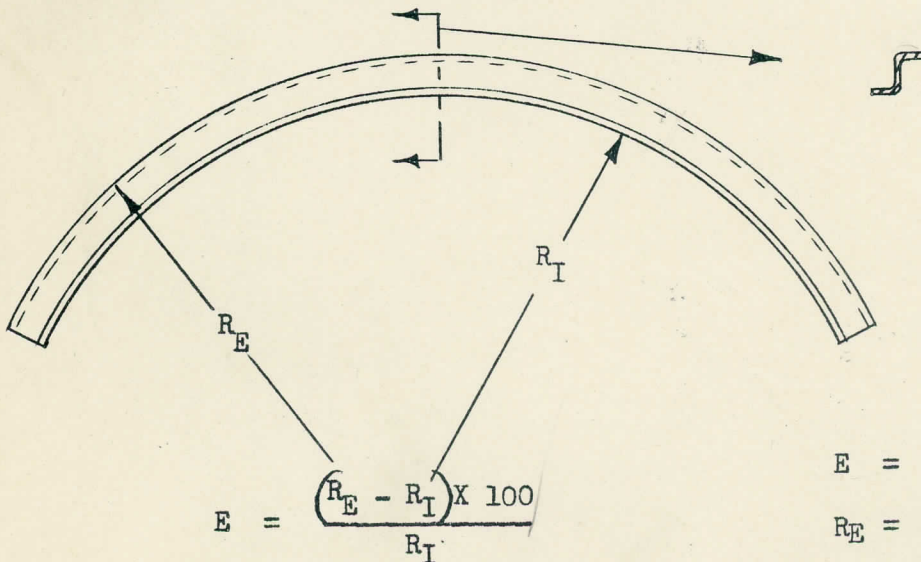
POSITIVE POSITION FORMING TEMPLATES ARE TO BE MADE OF 1/2 INCH PLYWOOD FOR SMALLER SIZES AND 3/4 INCH FOR LARGER SIZES. A SMALL NAIL IS PUT INTO FACE OF TEMPLATE AT CENTER LINE OF MACHINE FOR HOLDING RINGS ON ENDS OF SENSING TAPES, WHICH UNREEL FROM UNITS ATTACHED ABOVE EACH EXTRUSION JAW. CENTER LINE SHOULD BE SCRIBED ON TEMPLATE CORRESPONDING TO CENTER LINE OF STRETCH FORM FOR REFERENCE PURPOSES IN SETTING UP MACHINE.

THE SHAPE OF THE TEMPLATE IS DETERMINED FROM SHAPE OF STRETCH FORM AS SHOWN.

IT IS DESIRABLE TO HAVE RADIUS OF TEMPLATE SLIGHTLY LESS THAN STRETCH FORM RADIUS AT INNERMOST FIBRE OF PART. THIS MOVES NEUTRAL AXIS OF BEND INWARD TO WHERE IT IS NOT IN ACTUAL PART AND ELONGATES ALL SECTIONS OF PART PREVENTING COMPRESSION WRINKLES. IF POSSIBLE THERE SHOULD BE ABOUT 1% ELONGATION OF INNERMOST FIBRES OF PART.

FIRST CHECK AMOUNT OF ELONGATION OF EXTREME FIBRES OF SECTION AS FOLLOWS:

CONSTANT RADIUS FORM (RADIUS KNOWN):



WHEN

$E$  = PERCENTAGE OF ELONGATION

$R_E$  = RADIUS OF EXTREME FIBRES

$R_I$  = RADIUS OF INNERMOST FIBRES

EXAMPLE: ASSUME INSIDE RADIUS OF PART CURVE IS 29.00 & SECTION IS 1.00 WIDE.

$$E = \frac{(30-29) \times 100}{29}$$

$$E = \frac{100}{29} = 3.4\% \text{ ELONGATION REQUIRED TO STRETCH FORM}$$

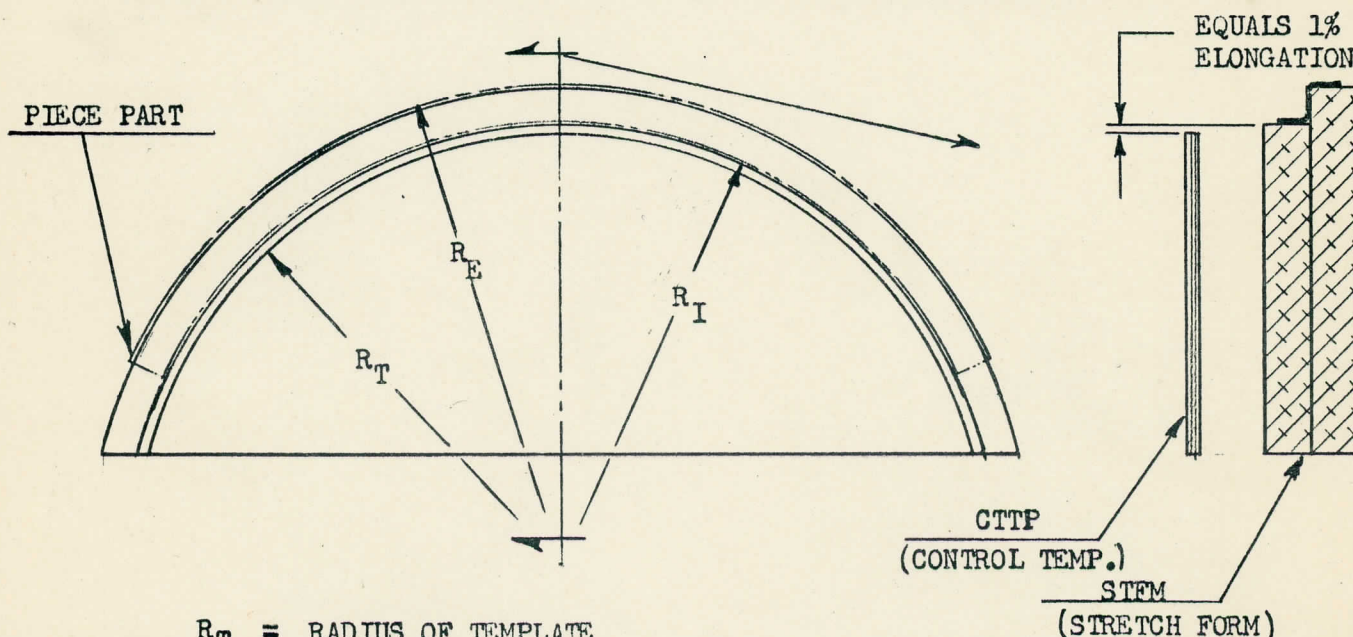
DRAWN	CAME 11-1-56	CTTP (CONTROL TEMPLATE) SHERIDAN E 40-12	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-5-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 153
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IF THIS PERCENTAGE OF ELONGATION IS WITHIN PERMISSABLE ELONGATION OF MATERIAL THEN PART CAN BE SUCCESSFULLY STRETCH FORMED. IF IT EXCEEDS MAXIMUM ELONGATION THEN PART CANNOT BE STRETCH FORMED.

WHEN THE AMOUNT OF ELONGATION REQUIRED TO FORM, AS DETERMINED BY FORMULA GIVEN, IS MORE THAN 1% BELOW MAXIMUM PERMISSABLE ELONGATION, TAKE THE DIFFERENCE BETWEEN  $R_E$  AND  $R_I$  (OR SECTION WIDTH IN PLANE OF FORM) AND DIVIDE IT BY PERCENTAGE OF ELONGATION REQUIRED TO FORM. SUBTRACT THIS AMOUNT FROM  $R_I$  (INNERMOST RADIUS) AND RESULT IS DIMENSION FOR RADIUS OF TEMPLATE. THE DIFFERENCE IN DIMENSIONS OF PART RADIUS AND TEMPLATE RADIUS THUS OBTAINED WILL THEN BE USED AS A CONSTANT DIMENSION BETWEEN FORM AND TEMPLATE FOR FULL LENGTH.

IF ELONGATION IS REQUIRED TO FORM IS 1% OR LESS BELOW MAXIMUM PERMISSABLE, THEN A COMPROMISE MUST BE MADE ON TEMPLATE TO KEEP ELONGATION WITHIN LIMITS.



$R_T$  = RADIUS OF TEMPLATE

$$R_T = R_I - \left( \frac{R_E - R_I}{E} \right)$$

USING SAME PART FOR EXAMPLE AS ON PREVIOUS PAGE

$$R_T = 29 - \left( \frac{30.00 - 29.00}{3.4} \right) \quad R_T = 29 - \frac{1.00}{3.4} \quad R_T = 28.706$$

DRAWN	ROBBINS 4-10-56	CTTP (CONTROL TEMPLATE) POSITIVE POSITION FORMING - SHERIDAN	TOOL FABRICATION PROCEDURES MANUAL
CHECKED			
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## POSITIVE POSITION FORMING TEMPLATE

NON CONSTANT (OR CONSTANT) FORM CURVES WHEN RADIUS IS NOT KNOWN:

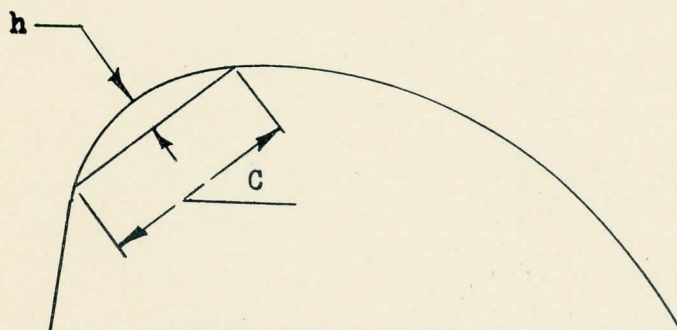
- a) DETERMINE RADIUS OR APPROXIMATE RADIUS, AS OUTLINED BELOW, OF SECTION WITH SHARPEST BEND.
- b) USING THIS RADIUS CALCULATE ELONGATION AND TEMPLATE RADIUS SAME AS OUTLINED FOR CONSTANT SECTIONS. SAME RELATION BETWEEN FORM AND TEMPLATE IS USED FOR FULL LENGTH.

TO DETERMINE RADIUS OF CURVE MEASURE OFF A CHORD ON SECTION HAVING SMALLEST RADIUS, OR CURVATURE APPROACHING TRUE RADIUS. THIS CHORD MAY BE OF ANY CONVENIENT LENGTH BUT THE LONGER THE BETTER AS LONG AS ARC IT SUBTENDS IS OF NEARLY CONSTANT RADIUS. MEASURE HEIGHT FROM THIS CHORD LINE TO MAXIMUM POINT ON ARC.

DETERMINE RADIUS USING THIS FORMULA:

$$r = \frac{c^2 - 4h^2}{8h}$$

r = RADIUS OF PART  
C = LENGTH OF CHORD  
h = HEIGHT FROM CHORD TO  
MAX. POINT ON ARC.



EXAMPLE: A CHORD 6.00 LONG IS LAID OUT ACROSS A CURVE AND DISTANCE FROM CHORD LINE TO MAXIMUM POINT ON ARC MEASURES .50.

$$r = \frac{6.00^2 + 4 \times .50^2}{8 \times .50}$$

$$r = \frac{36 + 1}{4} = 9.25$$

DRAWN	CAME 11-1-56	CTTP (CONTROL TEMPLATE) POSITIVE POSITION FORMING	TOOL FABRICATION PROCEDURES MANUAL
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APPROVED			

\*\*\*\*\*

TEMPLATES ARE TO HAVE 2.0 WIDE SLOTS TO CLEAR HOLD DOWN CYLINDER RODS. ONE SLOT TO BE ON  $\phi$  OF MACHINE AND FALL WITHIN 7.0 TO 39.0 RANGE OF ADJUSTMENT OF HOLD DOWN CYLINDER. A MINIMUM EDGE DISTANCE OF 3.0 IS DESIRABLE BUT MAY HAVE TO BE LESS ON EXTREMELY NARROW DIES.

3.18

Q OF FORM & MACH.

3.0 MIN.

L

6.0

2.0 TYP.

6.00 6.00

.38

\* \*

3/8 DRILL HOLES

\* DETERMINE AT TIME MACHINE IS SET UP FOR JOB.

DRAWN	ROBBINS 4-10-56	CTTP (CONTROL TEMPLATE) POSITIVE POSITION FORMING	TOOL FABRICATION PROCEDURES MANUAL
CHECKED			
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# SET-UP SHEET SHERIDAN E 40-12

PART NUMBER \_\_\_\_\_

D/C \_\_\_\_\_

LIMIT SWITCH SETTINGS:

L. H. ARM OUTBOARD \_\_\_\_\_

L. H. ARM INBOARD \_\_\_\_\_

L. H. POST ELONGATION \_\_\_\_\_

DIE TABLE FORWARD \_\_\_\_\_

DIE TABLE BACK \_\_\_\_\_

R. H. PRE-ELONGATION \_\_\_\_\_

R. H. POST ELONGATION \_\_\_\_\_

R. H. ARM OUTBOARD \_\_\_\_\_

R. H. ARM INBOARD \_\_\_\_\_

ARMS POWER INBOARD \_\_\_\_\_

POSITION SETTINGS:

OVERARM \_\_\_\_\_

DIE TABLE LEVELING SCREWS

HORIZONTAL

VERTICAL

LEFT HAND \_\_\_\_\_

RIGHT HAND \_\_\_\_\_

FORWARD \_\_\_\_\_

FLOW CONTROL SETTINGS:

TENSION CYLINDER

R. H. ARM \_\_\_\_\_

L. H. ARM \_\_\_\_\_

PRESSURE SETTINGS:

SYSTEM \_\_\_\_\_

JAW \_\_\_\_\_

STANDARD OPERATION \_\_\_\_\_

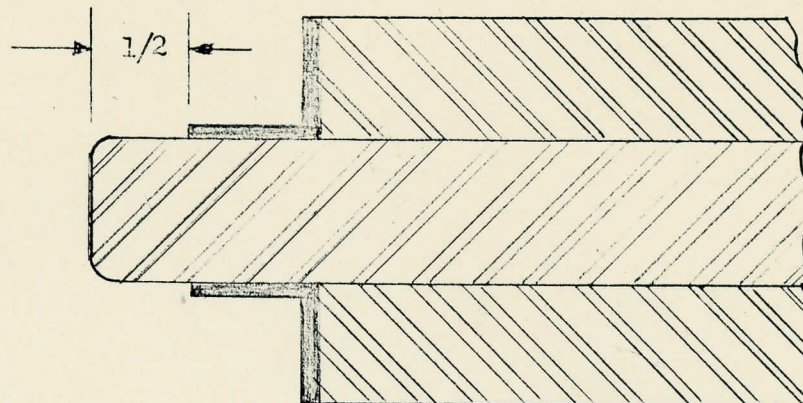
POSITIVE POSITION OPERATION \_\_\_\_\_

REMARKS:

SET-UP BY \_\_\_\_\_

DATE \_\_\_\_\_

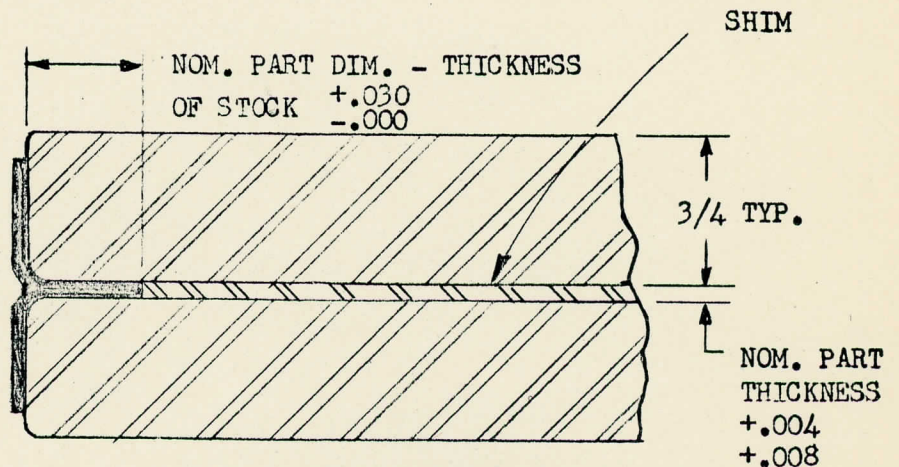
DRAWN	CAME 11-1-56	SET-UP SHEET SHERIDAN E 40-12	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-5-56		
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Y - 2 OR SIMILAR SECTIONS  
(LEG OUT)

ON HI'DEN STFM'S ADD A 6 X 6 C.R.S. PLATE  
WITH TAPPED HOLE FOR EYEBOLT. THE THICKNESS  
OF PLATE AND TAPPED HOLE SIZE SUITABLE FOR  
WEIGHT AND SIZE OF STFM. EYEBOLT SIZES  
AVAILABLE ARE 1/2-13, 5/8-11 AND 3/4-10.  
BOLT PLATE TO FORM (NO LAG SCREWS)

MATERIAL - DURAL PREFERRED  
HI'DEN ACCEPTABLE SUB.



Y - 2 OR SIMILAR SECTIONS  
(LEG IN)

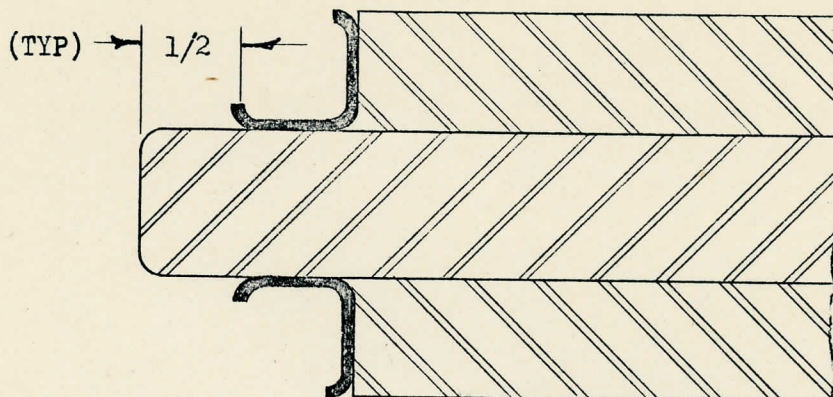
NOTE: THE PERIMETER OF STRETCHER  
FORM MUST BE GREATER THAN  
THE PART LENGTH BY 1" ON  
EACH END.

MATERIAL - DURAL

DRAWN	CAME 10-29-56	TYPICAL CONSTRUCTION HUFFORD STRETCHER FORMS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
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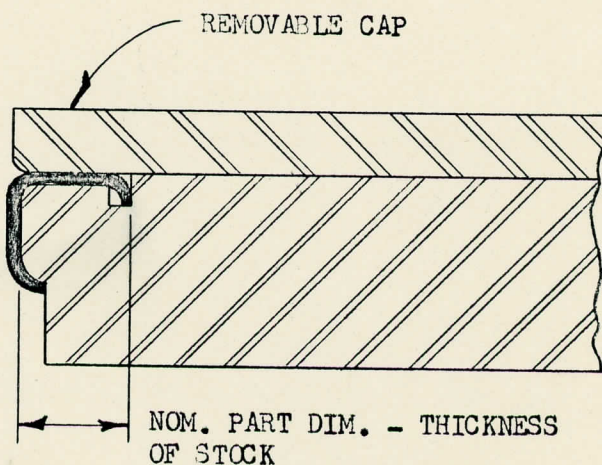
ON HI'DEN STFM'S ADD A 6 X 6 C.R.S. PLATE  
WITH TAPPED HOLE FOR EYEBOLT. THE THICKNESS  
OF PLATE AND TAPPED HOLE SIZE SUITABLE FOR  
WEIGHT AND SIZE OF STFM. EYEBOLT SIZES  
AVAILABLE ARE 1/2-13, 5/8-11 AND 3/4-10.  
BOLT PLATE TO FORM (NO LAG SCREWS).



Y - 3 OR SIMILAR SECTIONS  
(LEG OUT)

NOTE: FOR L. H. PART ONLY,  
BOTTOM MEMBER IS  
REMOVED.

MATERIAL - DURAL PREFERRED  
HI'DEN ACCEPTABLE SUBSTITUTE.



NOTE: SECTION MUST BE  
PRE-ROLLED.

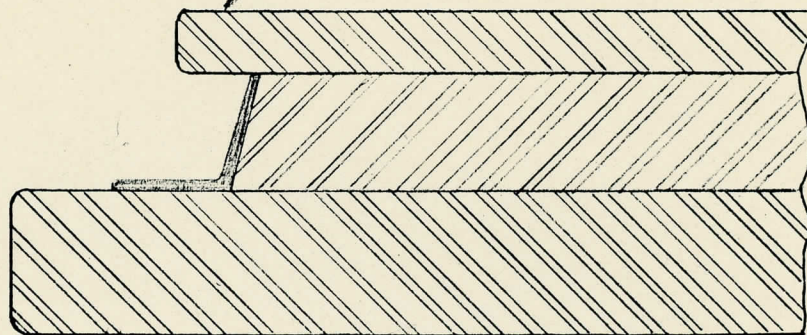
Y - 3 OR SIMILAR SECTIONS  
(LEG IN)

ON HI'DEN STFM'S ADD A 6 X 6 C.R.S. PLATE  
WITH TAPPED HOLE FOR EYEBOLT. THE THICKNESS  
OF PLATE AND TAPPED HOLE SIZE SUITABLE FOR  
WEIGHT AND SIZE OF STFM. EYEBOLT SIZES  
AVAILABLE ARE 1/2-13, 5/8-11 AND 3/4-10.  
BOLT PLATE TO FORM (NO LAG SCREWS).

MATERIAL - DURAL PREFERRED  
HI'DEN ACCEPTABLE SUBSTITUTE

DRAWN	CAME 10-29-56	TYPICAL CONSTRUCTION HUFFORD STRETCHER FORMS	TOOL FABRICATION PROCEDURES MANUAL
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ADD CAP FOR ANY SECTION  
WITH OPEN ANGLE.

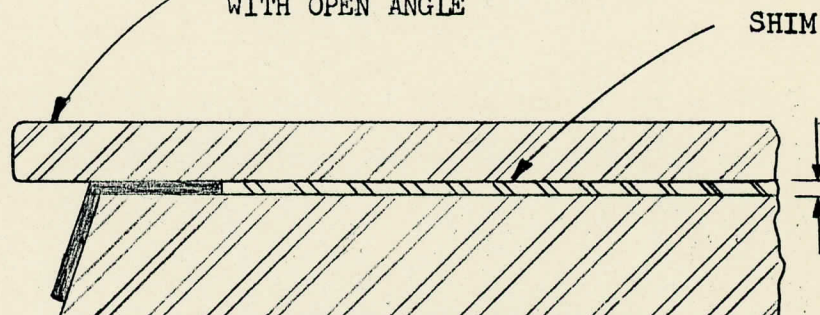


Y - 8 OR SIMILAR SECTIONS  
(LEG OUT)

ON HI'DEN STFM'S ADD A 6 X 6 C.R.S. PLATE  
WITH TAPPED HOLE FOR EYEBOLT. THE THICKNESS  
OF PLATE AND TAPPED HOLE SIZE SUITABLE FOR  
WEIGHT AND SIZE OF STFM. EYEBOLT SIZES  
AVAILABLE ARE 1/2-13, 5/8-11 AND 3/4-10.  
BOLT PLATE TO FORM (NO LAG SCREWS).

MATERIAL - DURAL PREFERRED  
HI'DEN ACCEPTABLE SUBSTITUTE

ADD CAP FOR ANY SECTION  
WITH OPEN ANGLE



Y - 8 OR SIMILAR SECTIONS  
(LEG IN)

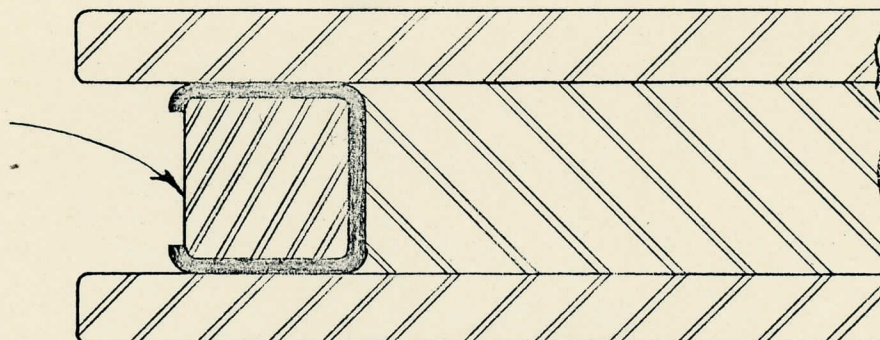
NOM. PART  
THICKNESS  
+.004  
+.008

MATERIAL - DURAL

DRAWN	CAME 11-1-56	TYPICAL CONSTRUCTION HUFFORD STRETCHER FORMS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 160
APPROVED			



SNAKE

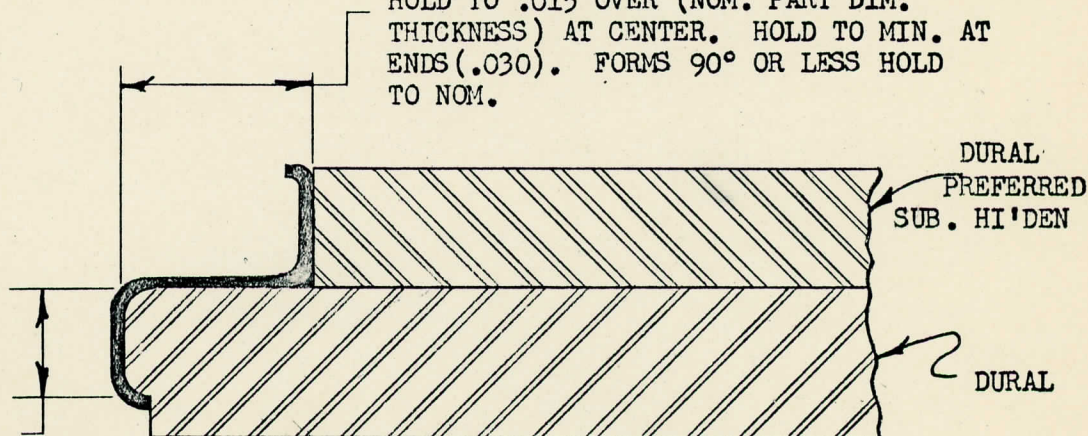


Y - 12 OR SIMILAR SECTIONS  
(LEG OUT)

ON HI'DEN STFM'S ADD A 6 X 6 C.R.S.  
PLATE WITH TAPPED HOLE FOR EYEBOLT.  
THE THICKNESS OF PLATE AND TAPPED HOLE  
SIZE SUITABLE FOR WEIGHT AND SIZE OF  
STFM. EYEBOLT SIZES AVAILABLE ARE  
1/2-13, 5/8-11 AND 3/4-10. BOLT  
PLATE TO FORM (NO LAG SCREWS).

MATERIAL - DURAL PREFERRED  
HI'DEN ACCEPTABLE SUBSTITUTE

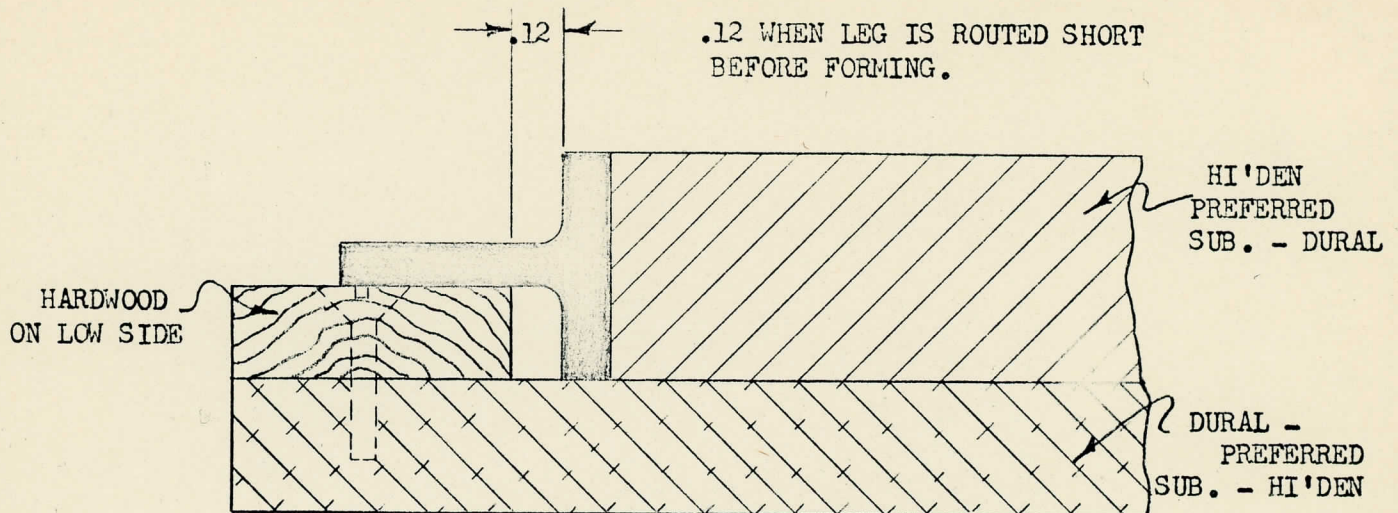
FOR SECTIONS FORMED ON HALF CIRCLE,  
HOLD TO .015 OVER (NOM. PART DIM.  
THICKNESS) AT CENTER. HOLD TO MIN. AT  
ENDS (.030). FORMS 90° OR LESS HOLD  
TO NOM.



1/32 UNDER NOM.  
PART DIM. -2 STOCK  
THICKNESS.

Y - 36 OR SIMILAR SECTIONS

DRAWN	CAME 11-1-56	TYPICAL CONSTRUCTION HUFFORD STRETCHER FORMS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-8-56		
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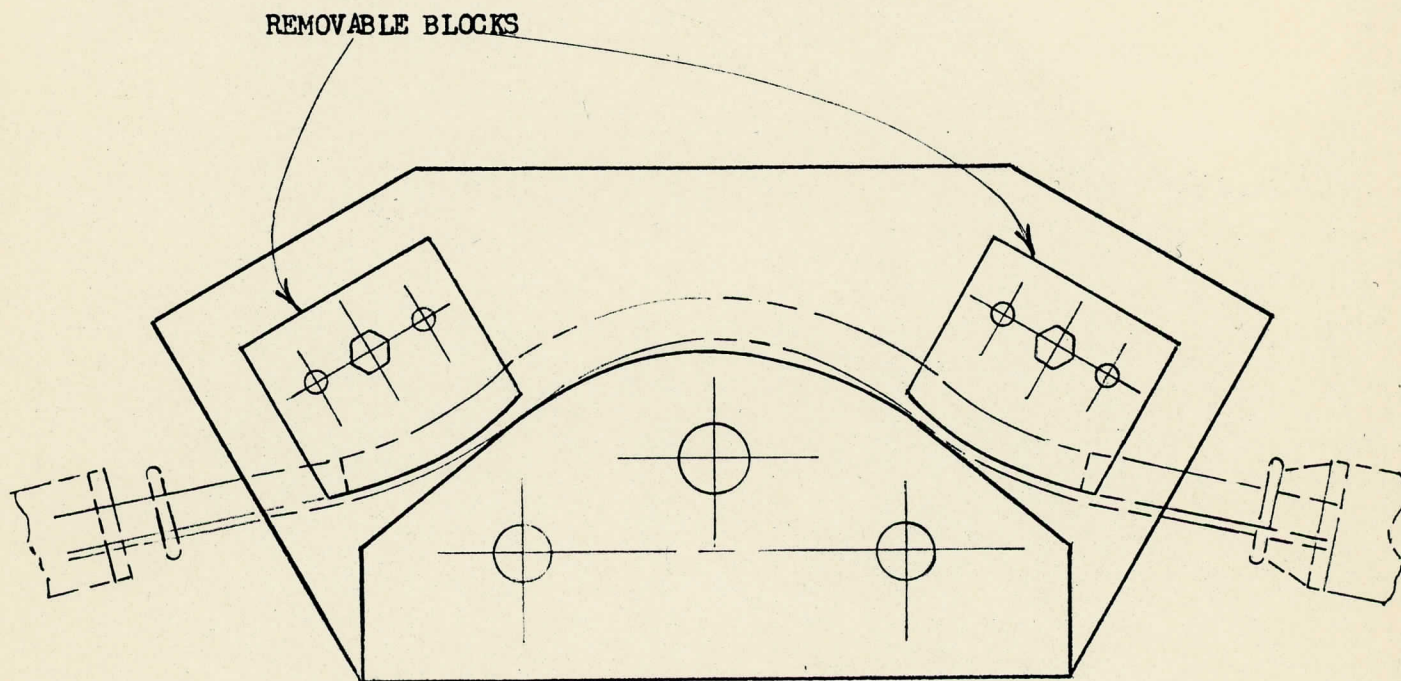


TEE SECTIONS PULLED WITH A LEG OUT MUST HAVE A SUPPORT TO KEEP LEG IN PLANE OF STATION.

ON HI'DEN STFM'S ADD A 6 X 6 C.R.S. PLATE WITH TAPPED HOLE FOR EYEBOLT. THE THICKNESS OF PLATE AND TAPPED HOLE SIZE SUITABLE FOR WEIGHT AND SIZE OF STFM. EYEBOLT SIZES AVAILABLE ARE 1/2-13, 5/8-11 AND 3/4-10. BOLT PLATE TO FORM (NO LAG SCREWS).

DRAWN	CAME 10-29-56	TYPICAL CONSTRUCTION HUFFORD STRETCHER FORMS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	RO-BINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 162
APPROVED			

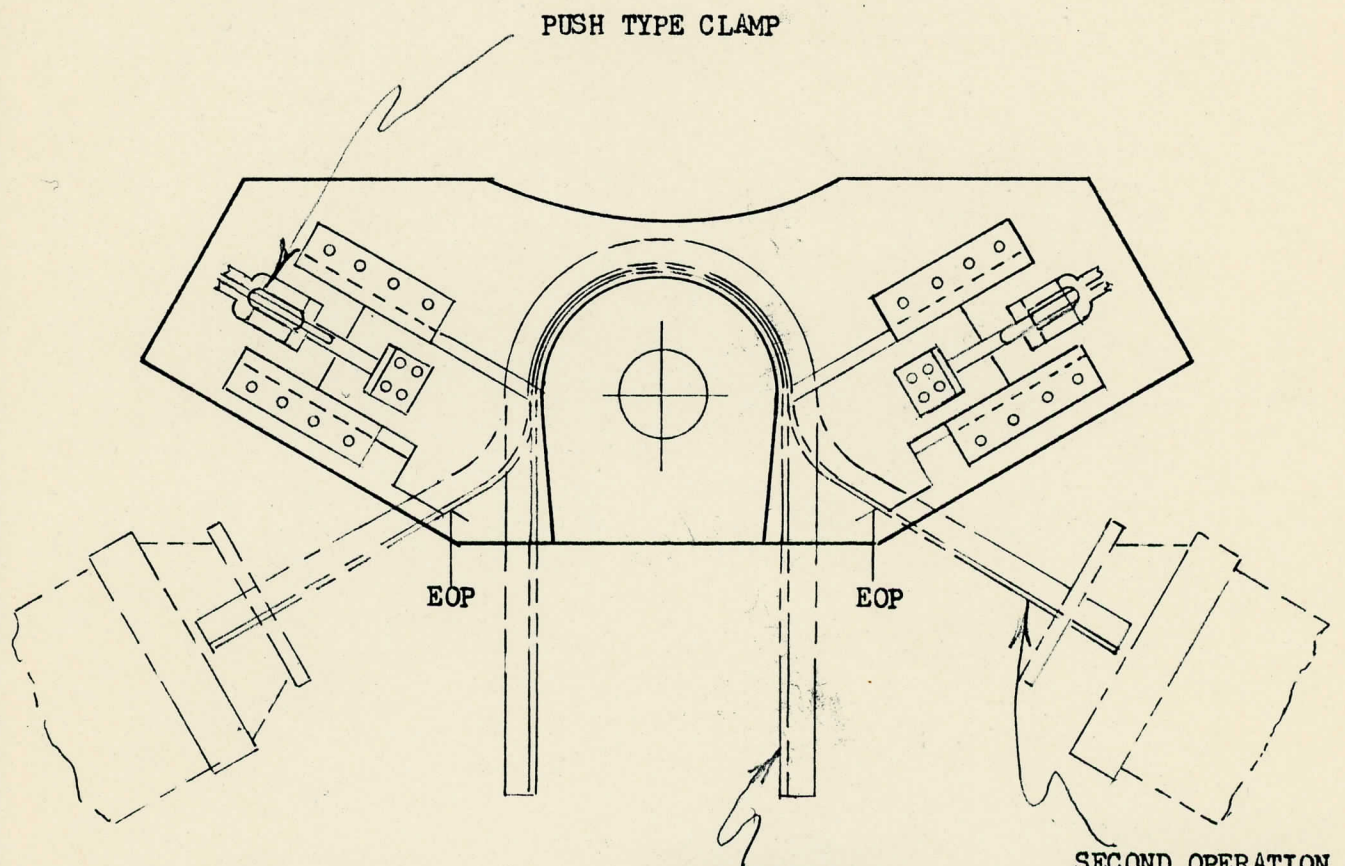




**NOTES:**

1. ALLOW 12" ADDITIONAL STOCK AT EACH END FOR GRIPPING.
2. FORM MUST BE BUILT SO CLEARANCE IS PROVIDED FOR STRETCHER JAWS AT ANY POSITION WHEN PART IS BEING FORMED.
3. STFM & BULLDOZER BLOCK USED ON SHERIDAN STRETCH PRESS.

DRAWN	CAME 10-30-56	REVERSE BEND STRETCH FORMING FOR HUFFORD	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 163
APPROVED			



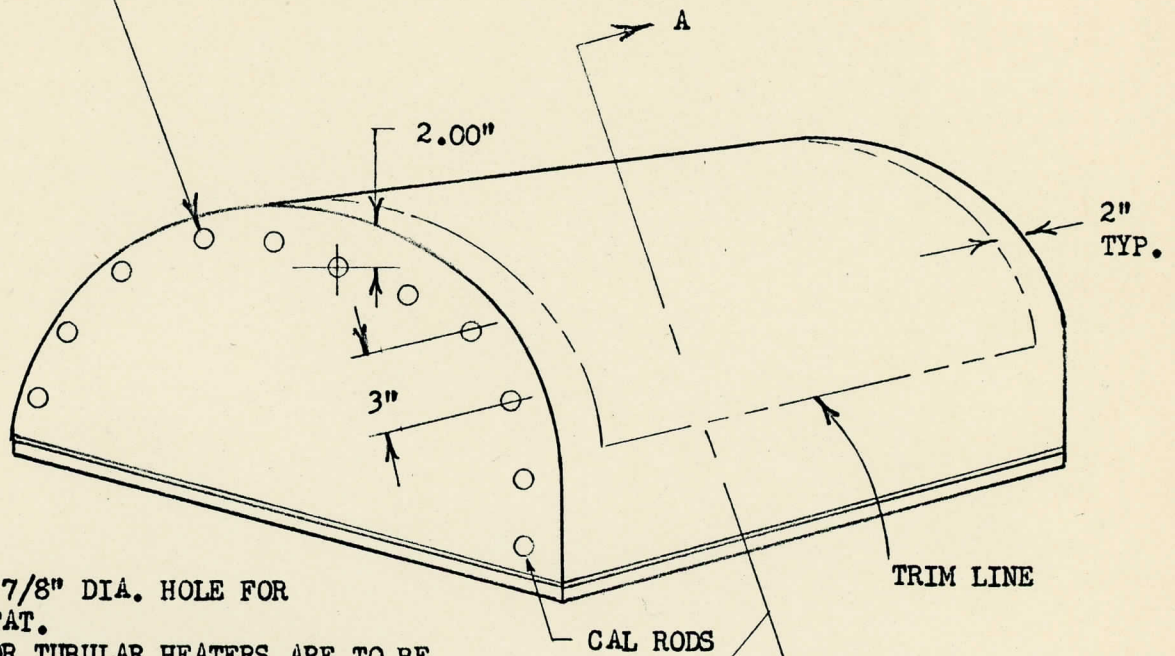
**NOTES:**

1. ALLOW 12" ADDITIONAL STOCK AT EACH END FOR GRIPPING.
2. FORM MUST BE BUILT SO CLEARANCE IS PROVIDED FOR STRETCHER JAWS AT ANY POSITION WHEN PART IS BEING FORMED.
3. STFM WITH BULLDOZER ATTACHMENT USED ON SHERIDAN STRETCH PRESS.

DRAWN	CAME 10-30-56	REVERSE BEND STRETCH FORMING FOR HUFFORD	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 164
APPROVED			



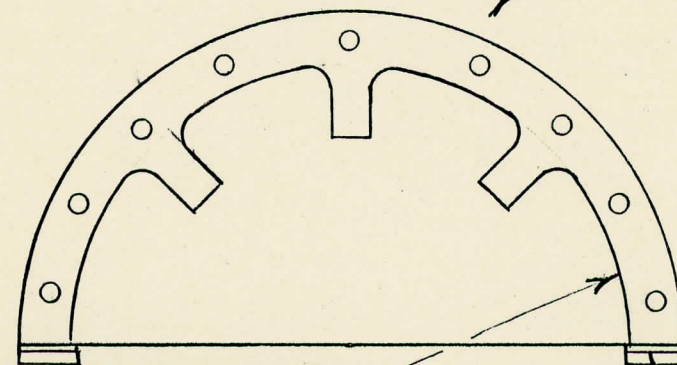
S.A.E. 4130 TUBING 1" O.D. X .058 WALL



**NOTES:**

1. PROVIDE 7/8" DIA. HOLE FOR THERMOSTAT.
2. TUBES FOR TUBULAR HEATERS ARE TO BE CAST IN PAIRS ON 3" CENTERS. TUBE SHOULD NOT PROTRUDE.
3. FAB. TO "TOPA"

MATERIAL  
CAST KIRKSITE OR  
CAST ALUMINUM



CORE TO BE DETERMINED  
BY PATTERN SHOP

1/16" STD. ASBESTOS SHEET  
MILLBOARD JOHNS-MANVILLE

1/4" ALUMINUM ALLOY STRIPS  
ATTACH WITH FLAT HD. SCREWS

DRAWN	CAME 10-30-56	TYPICAL HEATED STRETCH FORM FOR MAGNESIUM	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 165
APPROVED			

SERRATED BUSHINGS  
CVAC BUS. 2200 SERIES

DRILL SHELL

LOCATING BEADS  
ON TABS

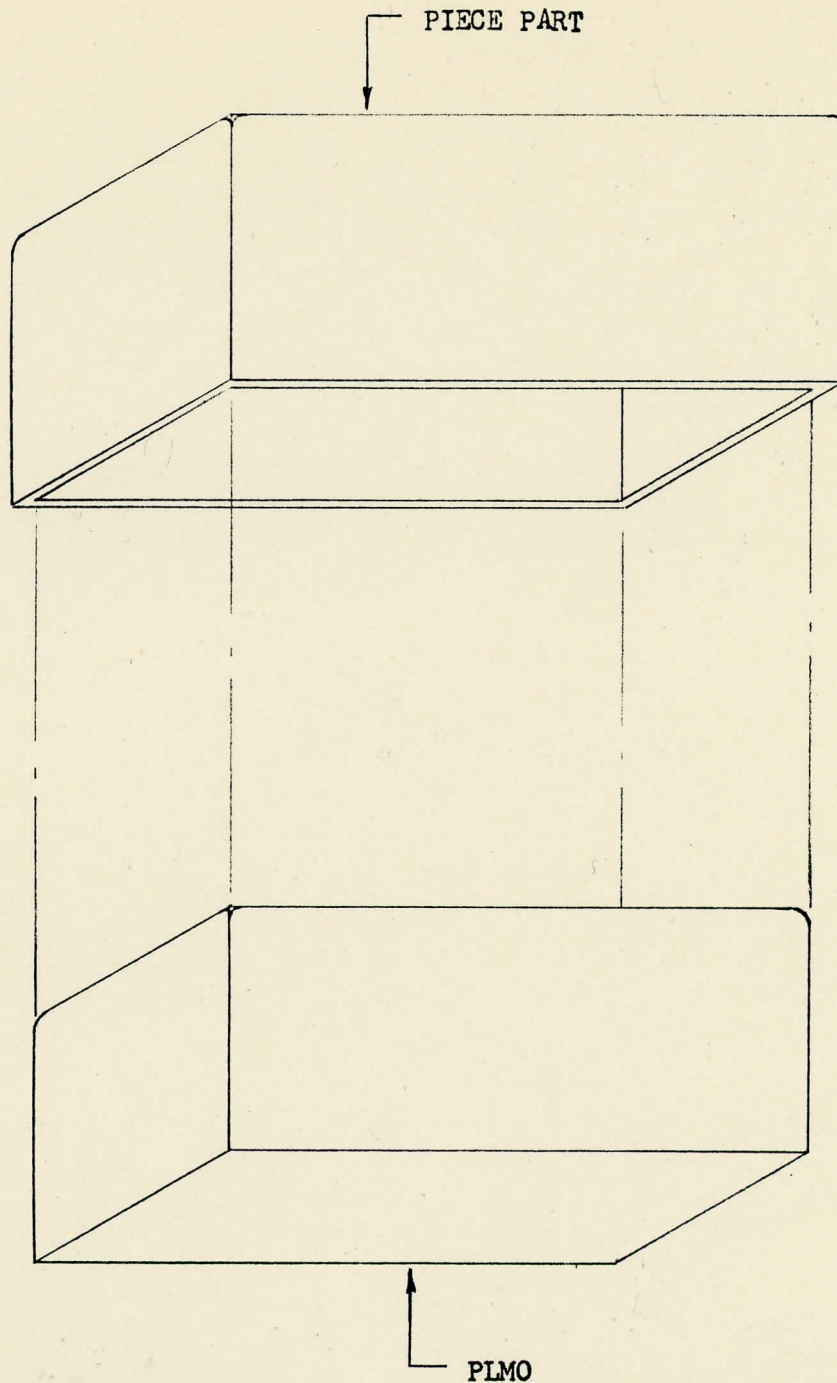
PIECE PART

MAKE FROM LAMINATED PLASTIC  
GLASS CLOTH

TRIM ALLOWANCE

DRAWN	GORDON 11-23-56	DRILL SHELL TOOL ILLUSTRATIONS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 170
APPROVED			

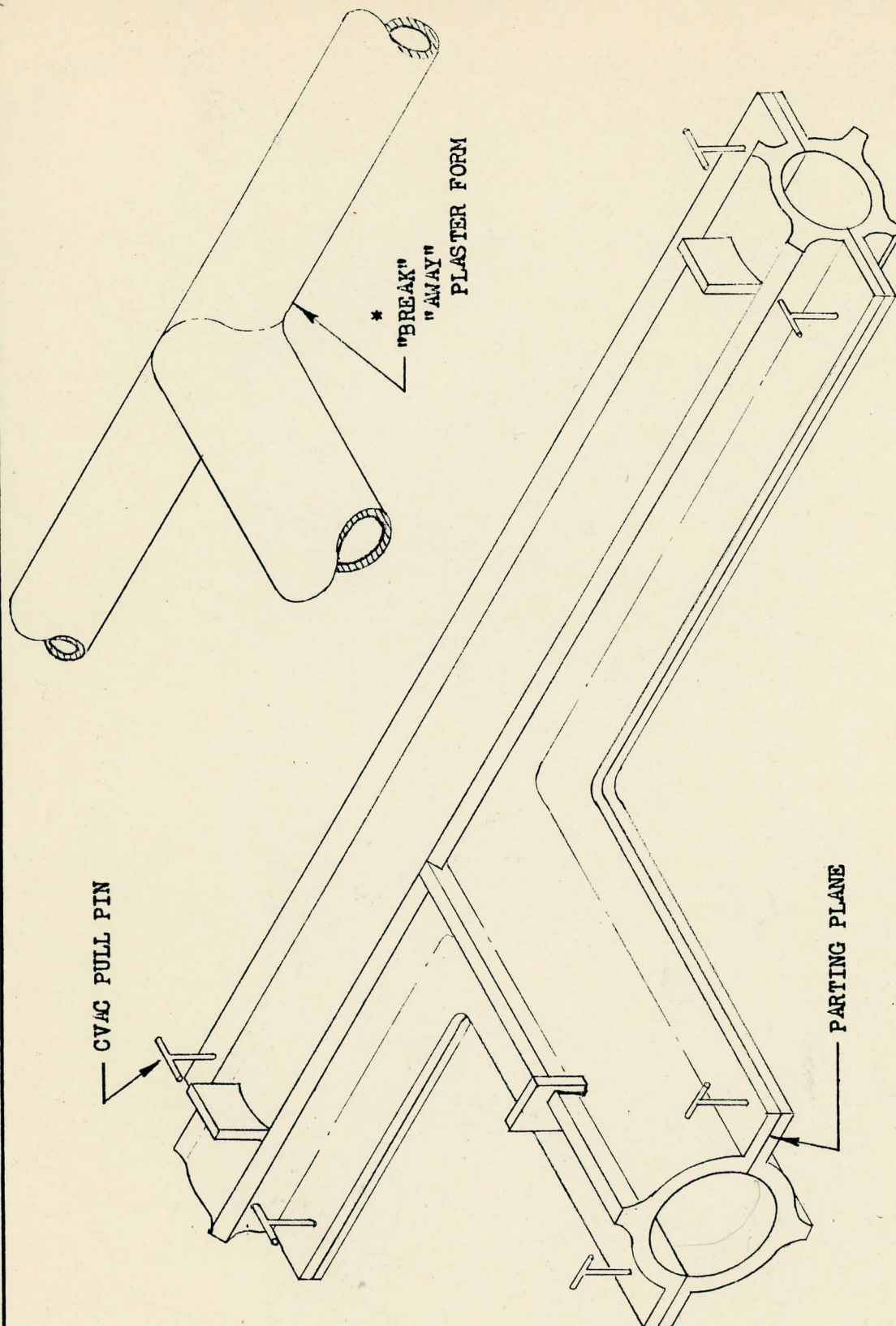




PLASTIC IS LAID UP DIRECTLY  
ON PLMO AND AFTER CURING  
STRIPPED FROM MOULD

MATERIAL - DURAL OR PLASTER

DRAWN	GORDON	11-1-56	PLASTIC MOULD "PLMO" TOOL ILLUSTRATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS	11-1-56		
APPROVED			CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 171
APPROVED				



LAMINATED PLASTIC GLASS  
CLOTH CONSTRUCTION

\* PLASTIC IS LAID UP ON PLASTER  
CAST MADE IN PLMO AND AFTER CURING  
PLASTER IS BROKEN OUT TO LEAVE  
PART.

DRAWN	GORDON	10-29-54
CHECKED	ROBBINS	11-1-56
APPROVED		
APPROVED		

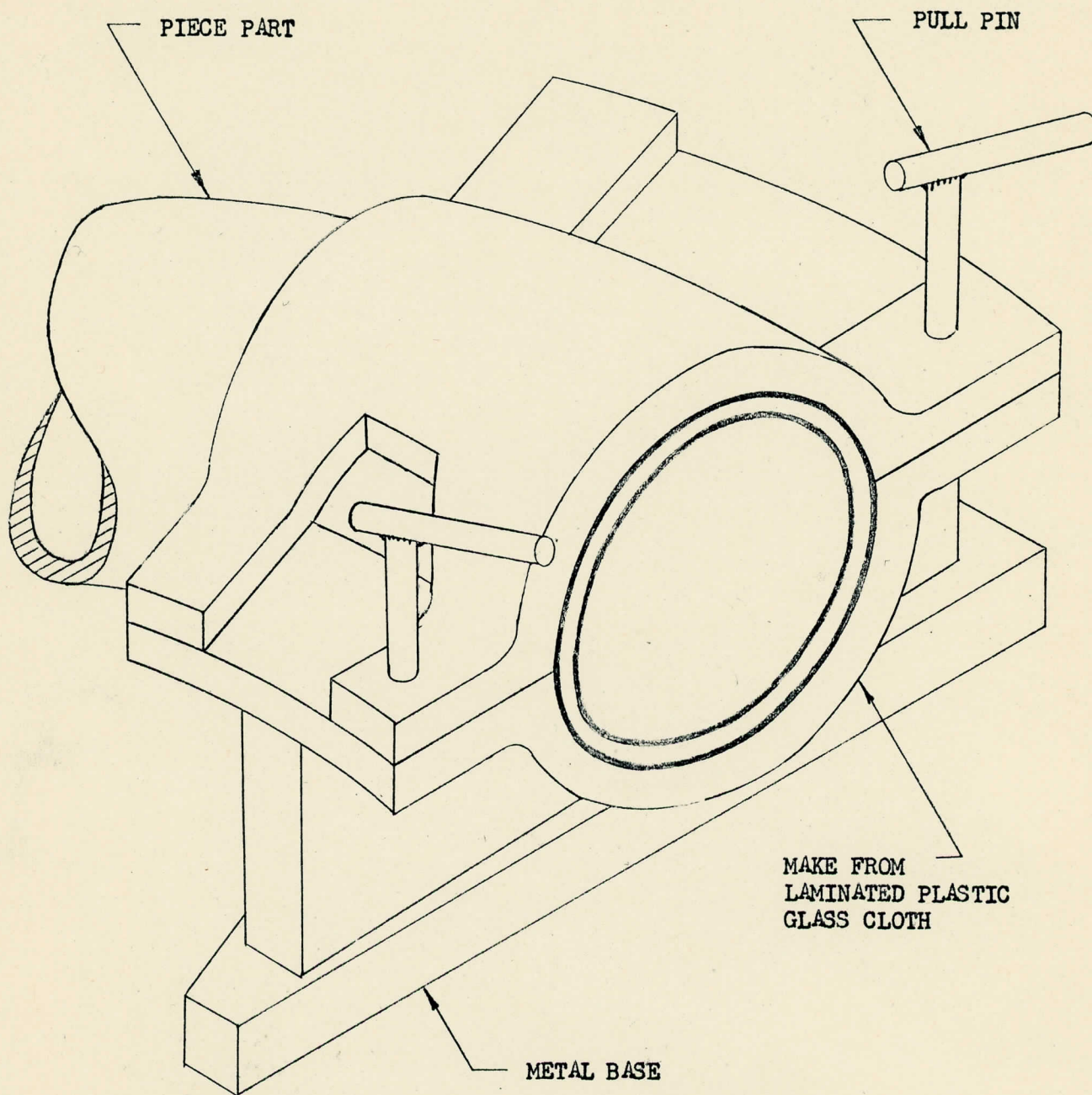
PLASTIC MOULD "PLMO"  
TOOL ILLUSTRATION

**CONVAIR**  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO

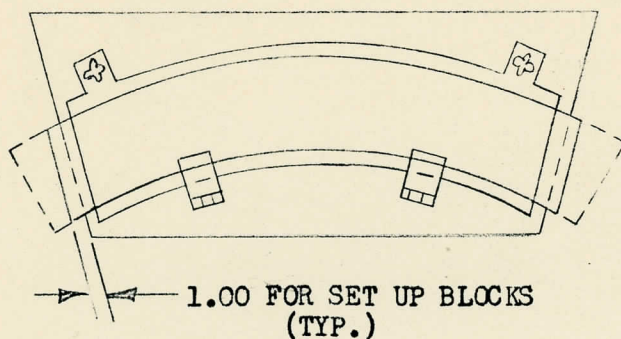
TOOL FABRICATION  
PROCEDURES  
MANUAL

PAGE 172



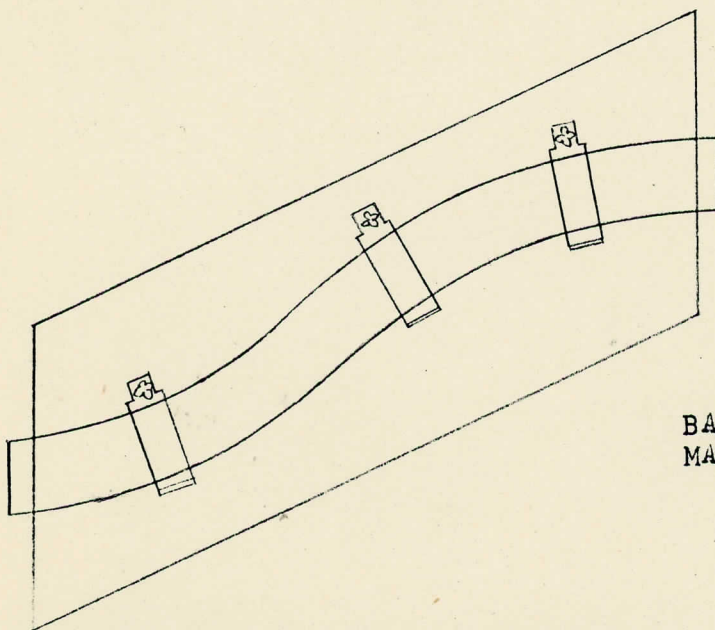
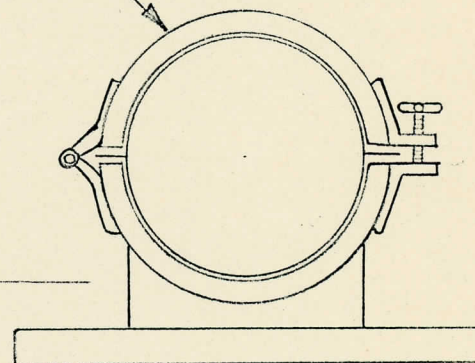


DRAWN	GORDON	10-25-56	SAW FIXTURE "SAFX" TOOL ILLUSTRATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS	11-1-56		
APPROVED			CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO	PAGE 173
APPROVED				



LAMINATED FIBER-GLASS  
CLAMPS

KEEP AS LOW AS PRACTICAL  
FOR SAFETY.



BASE TO BE MADE OF  
MASONITE OR DURAL

DRAWN	CAME 10-29-56	TYPICAL SAW FIXTURES FOR DUCTS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 174
APPROVED			



DIFFERENCE BETWEEN ROUGH & FINISH  
MARKED AND PAINTED YELLOW. REST OF  
TRSH PAINTED RED.

FINISH TRIM LINE

STFM

PRODUCTION  
PART

TRSH (ROUGH TRIM)

MAKE FROM PLASTIC GLASS CLOTH \*

\* CAN BE MADE OF SHEET METAL

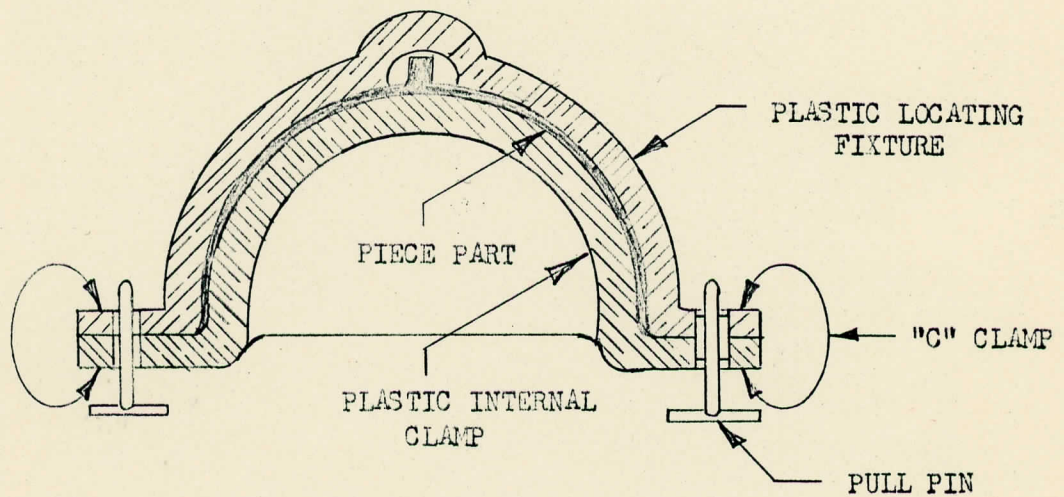
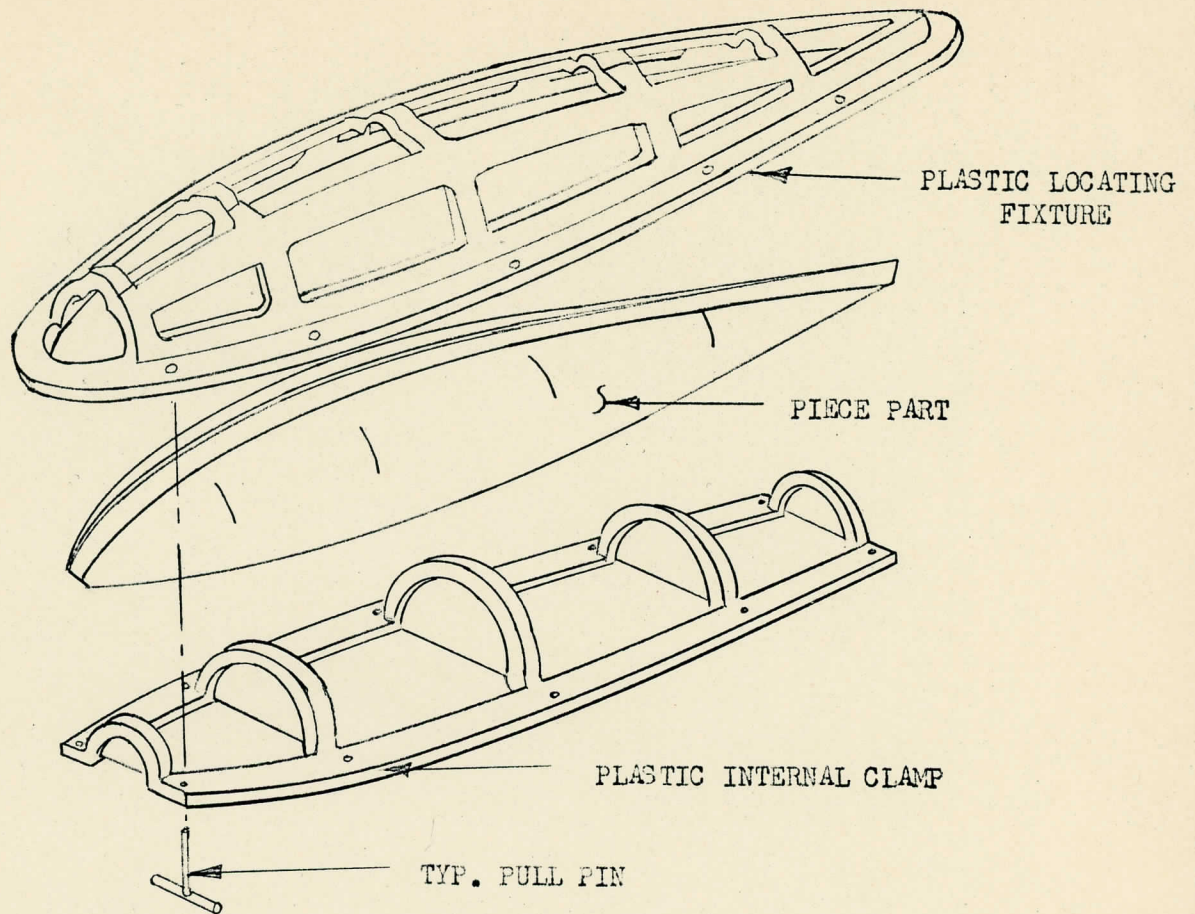
DRAWN	GORDON	10-2358
CHECKED	ROBBINS	11-1-56
APPROVED		
APPROVED		

TRIM SHELL  
TOOL ILLUSTRATIONS

**CONVAIR**  
A DIVISION OF GENERAL DYNAMICS CORPORATION  
SAN DIEGO

TOOL FABRICATION  
PROCEDURES  
MANUAL

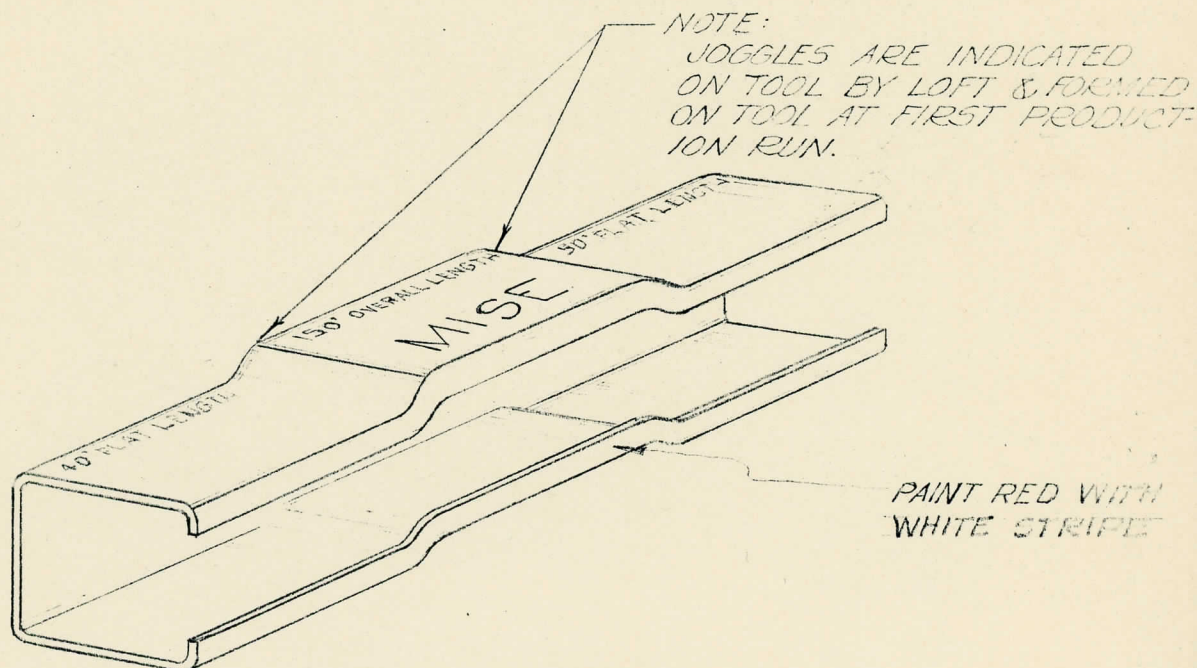
PAGE 175



TYPICAL CROSS SECTION

DRAWN	CAME 10-22-56	TYPICAL EXAMPLES OF PLASTIC TOOLING APPLICATIONS FOR WELD FIXTURES	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 10-25-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 176
APPROVED			





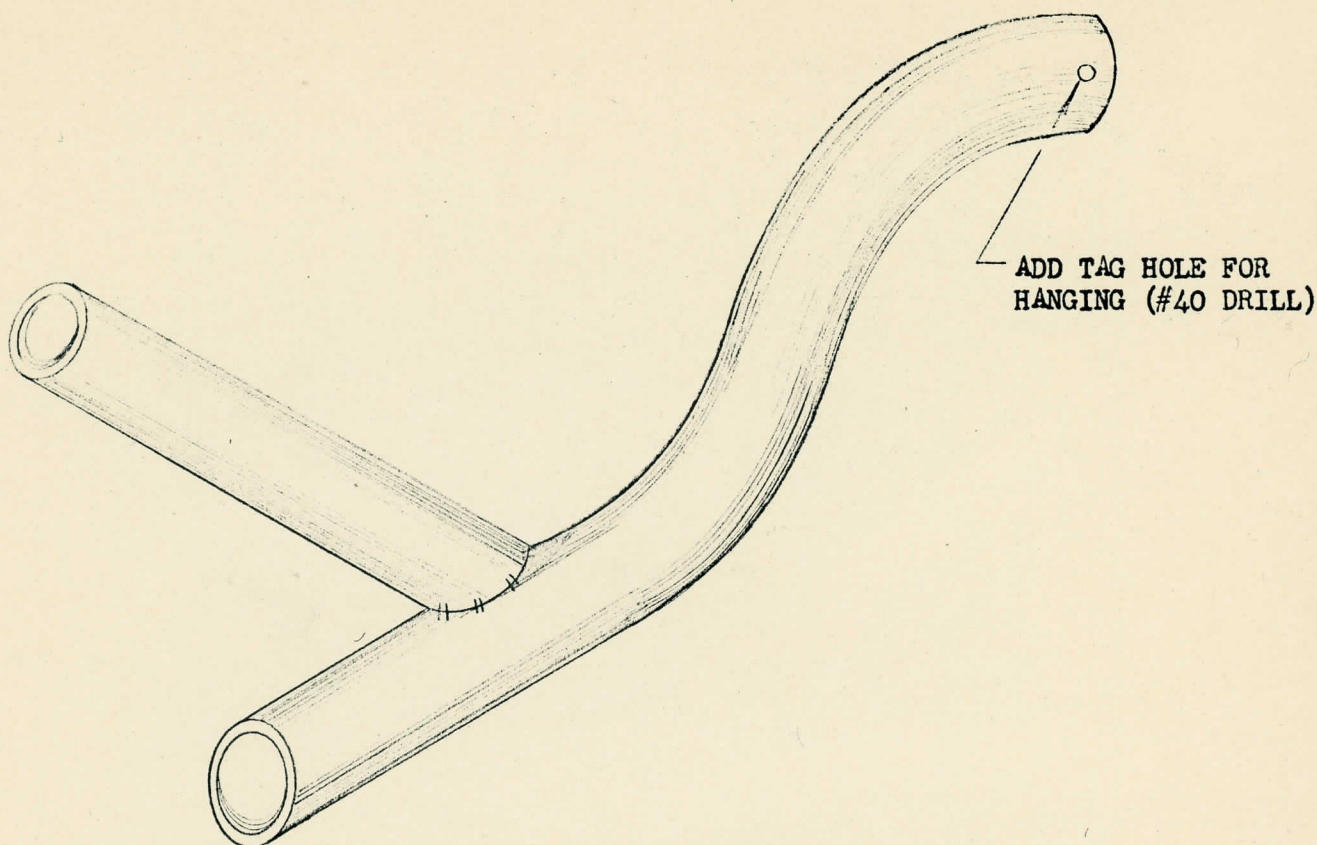
### MINIATURE SAMPLE

A part having all aspects of a part made to fit an assembly, but reduced in size, with the true dimensions clearly stamped on the sample. All cut-outs, joggles, holes, etc., which can be shown in their true relation to the ends or sides of the part will be on the sample. Long constant sections may be reduced in length or width, whichever is the case.

REVISED

ISSUED

DRAWN	CAME 10-26-56	MINIATURE SAMPLE	TOOL FABRICATION PROCEDURES MANUAL
APPROVED	ROBBINS 11-1-56		
APPROVED			
		CONSOLIDATED VULTEE AIRCRAFT CORPORATION SAN DIEGO DIVISION . . . SAN DIEGO, CALIFORNIA	
			PAGE 180

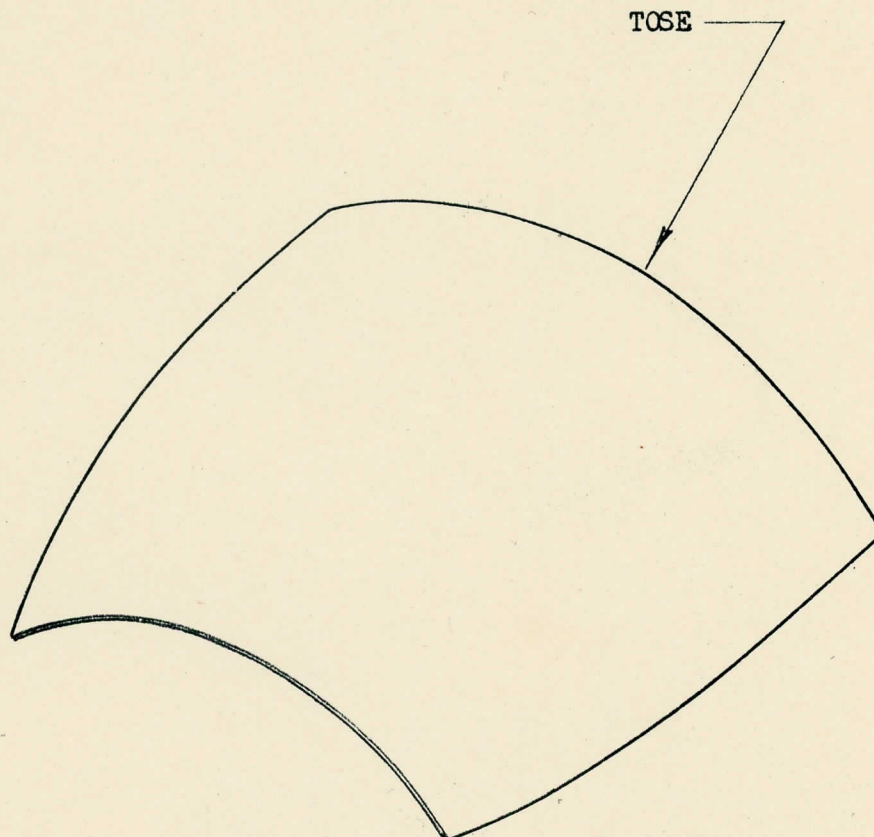


### PRODUCTION SAMPLE

A PART MADE TO SET AN ASSEMBLY FROM WHICH ALL OTHER PARTS ARE COPIED. THE MATERIAL THE PRODUCTION PART IS MADE OF IS INDICATED ON THE SAMPLE. THIS TOOL IS TO BE USED ONLY FOR STRUCTURAL TUBING, DETAIL PLANNING AND IN THE ELECTRIC, TUBING, AND FABRICATION PLANNING. RARELY USED AS A SET-UP TOOL IN MACHINE SHOP. THE PRODUCTION SAMPLE IS DISTINGUISHED FROM A PRODUCTION PART BY PAINTING THE SAMPLE. THE COLOR OF WHICH IS CODED AND CONTROLLED BY PROOF PLANNING BY MODELS.

DRAWN	CAME 10-26-56	PRODUCTION SAMPLE "PDSE"	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 181
APPROVED			





TOOLING SAMPLE IS MADE TO FIT AN ASSEMBLY,  
TO WHICH TOOLS ARE CHECKED. HOLES ARE MADE  
ACTUAL OR PILOT SIZE. THE MATERIAL OF PRO-  
DUCTION PART IS INDICATED ON SAMPLE. THE  
TOOLING SAMPLE IS PAINTED GREEN.

DRAWN	CAME 10-25-56	TOOLING SAMPLE "TOSE" TOOL ILLUSTRATION	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-2-56		
APPROVED		CONVAIR <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small> SAN DIEGO	PAGE 182
APPROVED			

THE FOLLOWING N.A.S. DEFINITIONS AND CONVAIR-SD EQUIVALENT DEFINITIONS AND TERMS ARE TO BE USED FOR REFERENCE ONLY. CONVAIR-SD STANDARD DEFINITIONS WILL CONTINUE TO BE USED AS HERE-TO-FORE.

# TERMINOLOGY FOR MASTERS DEFINITION & PREFERRED TERMS

## CONVAIR-SD EQUIVALENT TERMS

### MASTER (GENERAL)

A MASTER IS THE AUTHORITY WHICH PHYSICALLY ESTABLISHES NOMINAL DIMENSIONS AND WHICH CONTROLS THE ACCURACY OF AIRCRAFT TOOLS SO THAT PARTS AND/OR ASSEMBLIES MAY BE PRODUCED WITHIN ALLOWABLE TOLERANCE TO THESE NOMINAL DIMENSIONS.

SAME

### I MASTER-CONTROL

A CONTROL MASTER IS A DIMENSIONAL AUTHORITY TO CONTROL THE ACCURACY OF A MASTER OR MASTERS, AND SUPERSEDES THE MASTER AS THE AUTHORITY.

MSGA, MSLO, MSPE,  
TOML

PURPOSES: 1. A CONTROL MASTER IS NORMALLY REQUIRED:

(A) FOR THE FABRICATION AND CONTROL OF A MASTER OR DUPLICATE MASTERS SO AS TO SATISFY THE REQUIREMENT OF A PRODUCTION PROGRAM.

MSGA, MSLO, MSPE,  
TOML

(B) TO GUARD AGAINST LOSS OF DIMENSIONAL CONTROL IN CASE OF POSSIBLE DAMAGE TO MASTERS OR MASTERS.

MSGA, MSLO, MSPE,  
TOML

### II MASTER - (SPECIFIC)

A MASTER IS THE DIMENSIONAL AUTHORITY FOR THE CONSTRUCTION AND CONTROL OF PRODUCTION TOOLS, ESTABLISHING THE RELATIONSHIP BETWEEN HOLES, SURFACES, AND/OR CONTOURS OF A SPECIFIC PART, MATING PART, OR ASSEMBLY, OR A PORTION THEREOF.

FCGA, MSSE, MSTP,  
TOFM, TOGA, TOLO,  
TOML, TOPE, TOTP

PURPOSES: 1. TO INSURE INTERCHANGEABILITY BETWEEN AIRFRAME PARTS AND/OR ASSEMBLIES WHERE TOLERANCES REQUIRED ARE NOT COMPATIBLE WITH ORDINARY PRACTICAL MANUFACTURING PROCEDURE.

FCGA, TOGA, TOML,  
TOPE

2. TO FABRICATE AND CHECK AIRCRAFT PRODUCTION AND INSPECTION TOOLS, PARTICULARLY WHERE DUPLICATE TOOLS ARE REQUIRED.

FCGA, TOLO, MSSE,  
TOML, MSTP, TOFM,  
TOPE, TOGA, TOTP

3. TO DEFINE HOLE PATTERNS, CONTOURS, SURFACES, AND/OR CRITICAL ATTACH POINTS; IN GENERAL SIMULATING THE PRODUCTION PART OF ASSEMBLY BEING CONTROLLED.

FCGA, TOFM, TOGA,  
TOML, TOPE

DRAWN	CAME 11-1-56	TERMINOLOGY FOR MASTERS NATIONAL AIRCRAFT STDS. & CONVAIR EQUIVALENT TERMS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<div style="text-align: center;"> <b>C O N V A I R</b>  <small>A DIVISION OF GENERAL DYNAMICS CORPORATION</small>  <small>SAN DIEGO</small> </div>	PAGE 185
APPROVED			



TERMINOLOGY FOR MASTERS DEFINITION & PREFERRED TERMSCONVAIR-SD  
EQUIVALENT TERMS

## II. MASTER - (SPECIFIC) (CONT'D)

PURPOSES: 4. TO COORDINATE MASTERS OF ADJACENT AND/OR MATING PARTS OR STRUCTURES.

TOGA, TOML, TOPE

## III. MASTER-PART

A PART MASTER IS AN ACCURATELY CONSTRUCTED PRODUCTION PART MADE TO NOMINAL DIMENSIONS, AND ACCEPTED AS THE DIMENSIONAL AUTHORITY FOR THE FABRICATION AND/OR CO-ORDINATION OF TOOLS.

MSSE, TOSE

PURPOSES: 1. TO FABRICATE & CHECK AIRCRAFT PRODUCTION AND INSPECTION TOOLS.

MSSE, TOSE

2. TO SERVE AS A MASTER IN LIEU OF A SPECIFICALLY DESIGNED MASTER WHERE CLOSE DIMENSIONAL CONTROL IS NOT REQUIRED.

MSSE, TOSE

3. TO SERVE AS A MASTER WHERE CLOSE DIMENSIONAL CONTROL IS REQUIRED WHEN THE PART IS INHERENTLY DIMENSIONALLY STABLE, SUCH AS MACHINES CASTINGS OR FORGINGS.

TOSE

## IV. MASTER-FACILITY TOOL

A FACILITY TOOL MASTER IS AN AUXILIARY MASTER CONTROLLED BY ANOTHER MASTER TO FACILITATE TOOL MANUFACTURE AND/OR CONTROL. ADDITIONAL CONTOURS OR POINTS MAY BE ADDED WHICH ARE NOT CONTROLLED BY ANOTHER MASTER.

FCGA, TOGA, TOML, TOPE

PURPOSES: 1. TO EXPEDITE THE CONSTRUCTION AND CHECKING OF TOOLS WHEN THE MASTER IS LARGE OR CUMBERSOME.

FCGA, TOGA, TOML, TOPE

2. TO PROVIDE CONTROL OVER ADDITIONAL POINTS OR CONTOURS NOT ORIGINALLY INCLUDED IN THE MASTERING PROGRAM.

FCGA, TOGA, TOML TOPE

3. TO SERVE AS A TRANSFER MEDIA.

TOGA, TOML, TOPE

## V. MASTER-MODEL

A MODEL MASTER IS A FULL SCALE, THREE-DIMENSIONAL STRUCTURE WHICH ESTABLISHES THE COMPLETE OUTSIDE (OR INSIDE) SURFACES OF THE PART OR ASSEMBLY, AS DEFINED BY DESIGN-ENGINEERING DATA AND/OR LOFT LINES, AND MAY CARRY OTHER COORDINATING DATA, SUCH AS, TRIM LINES AND HOLES.

TOML

PURPOSES: 1. TO MAKE CASTS FOR DIES, FORM TOOLS, ETC.

TOML

DRAWN	CAME 11-1-56	TERMINOLOGY FOR MASTERS NATIONAL AIRCRAFT STDs. & CONVAIR EQUIVALENT TERMS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		CONVAIR <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 186
APPROVED			



TERMINOLOGY FOR MASTERS DEFINITION & PREFERRED TERMSCONVAIR-SD  
EQUIVALENT TERMS

## V. MASTER-MODEL (CONT)

- PURPOSES: 2. TO CONTROL CONTOURED AREAS NOT DEFINED BY ANY OTHER MEDIA. TOML
3. TO COORDINATE DETAIL AND ASSEMBLY TOOLS. TOML

## VI. MASTER-DRILL PLATE

A DRILL PLATE MASTER IS A MASTER THAT DEFINES A PATTERN OF HOLES IN A SINGLE PLANE, RELATING THEM TO REFERENCE POINTS, LINES, OR CONTOURS. MSPE, TOPE

- PURPOSES: 1. TO INSURE INTERCHANGEABILITY OF HOLE PATTERNS BETWEEN TWO MATING PARTS OR ASSEMBLIES. TOPE
2. TO FABRICATE & CHECK AIRCRAFT PRODUCTION AND INSPECTION TOOLS. TOPE
3. TO SERVE IN SOME CASES AS A CONTROL MASTER. MSPE

## VII. MASTER-TEMPLATE

A TEMPLATE MASTER IS A MASTER WHICH DEFINES CONTOUR AND/OR HOLE LOCATIONS IN A PLANE, AS RELATED TO REFERENCE POINTS OR LINES. MSLO, MSTP, TOLO, TOTP

- PURPOSES: 1. TO CONTROL WORKING TEMPLATES USED IN THE CONSTRUCTION OF DETAIL-PART TOOLS, SUCH AS, FORM BLOCKS, ROUTER BLOCKS, ETC. MSLO, MSTP
2. TO SUPPLEMENT MASTERS IN THE CONSTRUCTION OF ASSEMBLY TOOLS. TOLO, TOTP
3. TO AID IN THE CONSTRUCTION OF MASTERS TOLO
4. TO SERVE IN LIEU OF A DRILL PLATE MASTER WHEN HOLE LOCATION IS LESS CRITICAL. TOLO

DRAWN	CAME 11-1-56	TERMINOLOGY FOR MASTERS NATIONAL AIRCRAFT STDS. & CONVAIR EQUIVALENT TERMS	TOOL FABRICATION PROCEDURES MANUAL
CHECKED	ROBBINS 11-1-56		
APPROVED		<b>CONVAIR</b> <small>A DIVISION OF GENERAL DYNAMICS CORPORATION SAN DIEGO</small>	PAGE 187
APPROVED			